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Practical Navigation:

OR, AN

Ob. Holmes Book

Introduction to the Whole Art.

CONTAINING

The Doctrine of Plain and Spherical Triangles. Plain, Mercator, Great-Circle Sailing; and Aſtronomical Problems. The Uſe of divers Inſtruments; as alſo of the Plain-Chart, Mercator's Chart, and both Globes. Sundry Uſeful Tables in Navigation: And a Table of 10000 *Logarithms*, and of the *Logarithm-Sines*, *Tangents*, and *Secants*.

By **John Seller**, Hydrographer to the King.

The Seventh Edition, carefully Corrected.

LONDON;
Printed by *J. D.* for the Author at the *Hermitage* in *Wapping*,
and *Richard Mount* at the *Poſtern* on *Tower-Hill*, 1694.

Practical
NAVIGATION
or
An Introduction to the whole ART.

By John Seller
Hydrographer
to the KING.

THE PREFACE

To all COMMANDERS of Ships, and all other *Officers* and *Mariners* of our Engliſh Nation.

GENTLEMEN,

THE kind Acceptance of this Treatiſe amongſt you, hath encouraged the Continuation thereof unto the Seventh Impreſſion; it having had the Countenance and Aſſiſtance of an able Mathematician, in ſeveral Impreſſions, to render it the more compleat and uſeful: finding a general Approbation of all that are exerciſed in Nautical Affairs. In this Edition there hath been a Correction of ſeveral Errors, that have eſcaped in the former Impreſſions; and ſeveral Tables removed forward, that were expired. So hoping for as good Succeſs in this, as in the former Impreſſions, I commend it to the candid Cenſure of the Judicious, and reſt

Yours to ſerve you,

JOHN SELLER.

Hermitage in *Wapping*, *the* 26*th* of *May*, 1694.

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On the Practical Navigation of my very good Friend, Mr. *John Seller*.

YOur Book (kind Sir) I have perus'd, and find
Rich Arguments of an ingenious Mind ;
That for our Good your Talent will not hide,
But build a *Light-Houſe*, Mariners to guide.
What others have in mighty Volumes done,
You neatly here have couched all in one ;
Yet is your Book to no great Volume grown,
Tho grac'd with learn'd Additions of your own.
For me to praiſe your Work, might be my blame,
Fearing my Meanneſs might diſpraiſe the ſame.
You want not learned Pens in lofty Verſe,
Your well-deſerved Praiſes to rehearſe.
Mean Artiſts, Men obſcure (and ſuch am I)
Ought t'wiſh and pray for your Proſperity.
Yet rouſe (for once) my humble Muſe, and let
The Country Oat-Pipe drown the Flagelet.
And 'tis but fitting (ſith your Pains in this
To City and to Country uſeful is)
That City-Poetry, and Country-Lays,
With joint Conſent ſhould eccho forth your Praiſe.
Who doth peruſe your Work, ſhall ſurely find,
The Subject handled well, and well-deſign'd.
You much have done in little ; here we find
What in this Art may pleaſe a curious Mind,
The *Longitude* excepted : but if we
Your Rules obſerve, obtained it may be
For uſe ſufficient ; but the ſame to get
With certainty, is not diſcovered yet.

Which rare Performance, if that any can
Make plainly out, I wiſh you be the Man.
But ſtay, my Muſe, be ſhort and not ſo rude;
I'll only wiſh you well, and ſo conclude.
May theſe your Labours (as they profit all)
Turn to your Profit, and your Good withal.
May no baſe Plagiary arrogate
That to himſelf, which you by Pains have got.
May never Engliſh-Man be ſo unkind
(As famous * *Wright*, and reverend † *Ward* do find)
T'aſcribe to Strangers what you have ſet forth,
Detracting ſo from their and your true Worth.
May you encouraged be, as Reaſon is,
To publiſh more ſuch uſeful Works as this.
May you be happy ever in the End:
Thus prays your humble Servant, and your Friend,

* Maſter *Wright*'s Chart aſcribed to *Mercator*.
†Dr. *Wards* Invention of a Triangle in an Ellipſis, & applied to Aſtronomy, aſcribed to *Co. Pagan*.

Weſterleigh in *Gloceſterſhire*,
ſix Miles from *Briſtol*,
Sept. 20. 1672.

Nathaniel Friend.

Wat

Advertiſement.

ALL ſorts of Meridian, Azimuth and Amplitude Compaſſes, Plats, Sea-Charts, both plain and *Mercator*'s, with Logs, Logboards, Leads and Lines, Books and Inſtruments, or any other things belonging to the Art of Navigation, are ſold by *John Seller* at the *Hermitage* in *Wapping*: alſo ſeveral new Books of Geography, and Maps, both great and ſmall, for any part of the World.

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Advertiſement.

IN *Preſcot-Street* in *Goodmans-Fields*, are taught theſe Mathematical Sciences: *Viz. Arithmetick, Geometry, Algebra, Trigonometry, Navigation, Aſtronomy, Surveying, Gauging, Dialling, Fortification,* and *Gunnery*; likewiſe the Uſe of the Globes, and other Mathematical Inſtruments; the Projection of the *Sphere*, and other Parts of the Mathematicks.

By *JOHN COLSON*,

Who formerly lived in *Marſh-Yard* in *Wapping*.

Practical Navigation:

OR AN

Introduction to the whole Art.

CHAP. I.

A Preliminary Diſconrſe of Navigation and Arithmetick.

SECT. I.

Of the Preliminary Diſcourſe of Navigation.

NAVIGATION (that uſeful part of the *Mathematicks*) is a Science which has been highly valued by the Antients, eſpecially by our Anceſtors of this Iſland; it being indeed the Beauty and Bulwark of *England*, the Wall and Wealth of *Britain*, and the Bridg that joins it to the Univerſe.

It conſiſts of two general Parts.

Firſt, That which may be called the *Domeſtick*, or more *common Navigation*, (I mean Coaſting, or Sailing along the Shore.) This Part employs the Mariners *Compaſs* and *Lead*, as the chief Inſtruments; and for an Introduction of this kind, I refer you to my Book, entitled, *The Engliſh Pilot*, and *Sea-Atlas*, deſcribing the Sea-Coaſts, Capes, Soundings, Sands, Rocks, and Dangers; the Bays, Roads, Harbors, Rivers, and Ports, in moſt of the known Parts of the World: *Being furniſhed* with new and exact Draughts and Deſcriptions, collected from the Experience of divers of our *able Navigators*; the like not heretofore publiſhed in *England.*

Secondly, That which may more properly bear the Name, and principally deſerves to be entituled the *Art of Navigation*, is that part which guides the Ship in her Courſe through the Immenſe Ocean, to any part of the known World; which cannot be done, unleſs it be determined in what Place the Ship is at all times, both in reſpect of *Latitude* and *Longitude*; this being the principal Care of a *Navigator*, and the *Maſter-piece* of *Nautical Science.*

To the commendable Accompliſhment of which Knowledg, theſe four Things are ſubordinate Requiſites:

viz.
Arithmetick,
Geometry,
Trigonometry, and
The Doctrine of the Spheres.

Of the firſt of which (namely *Arithmetick*) I ſhall give you a brief Specimen.

Arithmetick is the Art of Numbring, from the Greek Word *Arithmos*, which ſignifies Number; and in it there are five eſpecial Parts, *viz.* *Numeration*, *Addition*, *Subtraction*, *Multiplication*, and *Diviſion*. Of which in Order.

SECT. II.
Of NUMERATION.

NUmeration teaches how to ſet down any Number ſpoken or propoſed; and to read it truly when written.

To which purpoſe you are to obſerve, That Numbers are commonly expreſſed by theſe Nine Figures,

1	2	3	4	5	6	7	8	9
One,	*Two,*	*Three,*	*Four,*	*Five,*	*Six,*	*Seven,*	*Eight,*	*Nine.*

And 0 which is called a Cypher, (and by ſome a Nought) becauſe of it ſelf ſignifies nothing, yet encreaſes the Value of other Figures that ſtand behind it; for every Figure augments its proper Value according to the Place it happens in, except the firſt: And are reckoned from the Right-hand unto the Left, (and the Reaſon is, becauſe this Art of Numbering was firſt taught by the Oriental Nations, whoſe Languages are read that way) ſo that the Figure that ſtands fartheſt to the Right-hand is ſaid to be in the firſt place, the next to that to be in the ſecond place, and ſo of the reſt.

Any of the nine Figures in the firſt place ſignifies only its ſingle Value; in the ſecond place, as many Tens as its own ſimple Value; in the third place, ſo many Hundreds; in the fourth place, ſo many Thouſands; in the fifth place, ſo many Ten Thouſands; the in ſixth place, ſo many Hundred Thouſands; and in the ſeventh place, ſo many Millions; as may appear in this following Table.

Units	1	2	3	4	5	6	7	8	9
Tens		1	2	3	4	5	6	7	8
Hundreds			1	2	3	4	5	6	7
Thouſands				1	2	3	4	5	6
Ten Thouſands					1	2	3	4	5
Hundred Thouſands						1	2	3	4
Millions							1	2	3
Ten Millions								1	2
Hundred Millions									1

To be read this Way.

The laſt Line of this Table is thus read, *One hundred twenty three Millions, four hundred fifty ſix thouſand, ſeven hundred eighty nine.*

SECT. III.

ADDITION.

A*Ddition* is the putting together of two or more Numbers into one Sum, ſo that the total Value of them all may be diſcovered.

Example 1. *in whole Numbers.*

Suppoſe there were a Squadron of Men of War of five Ships, I demand (according to the quantity of Men in each Ship) how many Men there are in the whole Squadron?

Aboard

Aboard of the biggeſt Ship there are	500
Aboard another,	450
Aboard another,	362
Aboard another,	278
Aboard the laſt,	110
There are in the Squadron	1700

To add theſe together, begin at the firſt Row on the Right-hand, and ſay 8 and 2 is 10, ſet down 0 under the firſt; then I carry the 1 (which ſtands for 10) to the next Row, and ſay 1 and 1 is 2, and 7 is 9, and 6 is 15, and 5 is 20; then ſet down 0 under the ſecond Row, and carry the 2, which is 20, to the next Row, and ſay 2 and 1 is 3, and 2 is 5, and 3 is 8, and 4 is 12, and 5 is 17; which 17 ſet down under the third Row, and the Sum is 1700, the Number of Men in the whole Squadron.

Example 2. of Pounds, Shillings, Pence.

Now if you would know how much Money all the Captains Pay comes to for one Month.

	l.	s.	d.
Suppoſing that the Captain of the greateſt Ship hath *per* Month	10	00	00
The Captain of the other Ship	08	10	00
The Captain of the other	07	10	00
The Captain of the other	06	10	00
The Captain of the laſt	05	00	00
	37	10	00
The Queſtion is, *How much Money it amounts to for 1 Month?* Anſwer	l. 37	s. 10	d. 00

To effect which you muſt begin at the Row of Pence, and ſeeing there is no Pence in the whole Row, you muſt ſet down 00 under the Row of Pence. Then proceed to the Row of Shillings, and add up the Shillings in that Row which amounts to 30 Shillings; ſet down the 10 Shillings under the Row of Shillings, and carry the 20 Shillings, or one Pound, to the Row of Pounds, and ſay 1 and 5 is 6, and 6 is 12, and 7 is 19, and 8 is 27, and 10 is 37, which 37 ſet down under the Row of Pounds; and the whole Sum amounts to *Thirty ſeven Pounds, Ten Shillings*, the Sum of all the Captains Pay for one Month.

SECT. IV.

Of SUBTRACTION.

Subtraction (commonly called *Subſtraction*) is a Rule that teaches how to take any leſſer Number out of a greater, ſo as to know how much remains.

1. Set down your greater Number, and under that your ſmaller, Units under Units, Tens under Tens, *&c.* and in Money each Denomination anſwering to its kind, as Pence under Pence, Shillings under Shillings, and Pounds under Pounds.

2. Draw a Line under them, and begin at the Right-hand, and take the leſſer Number out of the greater, and ſet down what remains under the Line.

3. If any Figure of the ſmaller Number happen to be bigger than that over it, then you muſt borrow a Unit from the next Place, or higher Denomination, to be added to the leſſer Figure, ſubtracting from that Sum, and ſubſcribe the Remainder; which Unit muſt be added to the next place, or Denomination to be ſubtracted; as will appear in the Example following.

Example.

	℔.	*s.*	*d.*
Suppoſe I borrow	296	15	06
And I paid at ſeveral Times	125	17	04
There remains due	170	18	02

The Work is thus performed; begin with the Row of Pence, and ſay 4 from 6, and there remains 2; then go to the Row of Shillings, and ſay 17 from 15 I cannot take, then you muſt borrow 20 Shillings from the Row of Pounds, and ſay 17 from 35, and there remains 18, which 18 ſet under the Row of Shillings: Then proceed to the Row of Pounds, and ſay, 1 that I borrowed and 5 is 6, 6 from 6 and there remains 0, which 0 ſet under the firſt Row of Pounds; and proceed to the next, and ſay, 2 from 9 and there remains 7; which 7 ſet under the ſecond Row, and proceed to the third Row, and ſay 1 from 2 and there remains 1; then is the Queſtion finiſhed, and there remains 170 ℔. 18 *s.* 2 *d.* unpaid.

And the Queſtion ſtands thus,

Now to prove whether the Queſtion is truly wrought, add the Remainder and the lower Number together; and if the total of that Addition be the ſame with the upper Number, then is the Work right.

℔.	*s.*	*d.*
296	15	06
125	17	04
170	18	02
296	15	06

SECT. V.

Of MULTIPLICATION.

1. M*Ultiplication* teaches how to encreaſe the greater of two Numbers given, as often as there are Units in the leſſer; and ſerves inſtead of many Additions.

2. In Multiplication there are three Parts.
   1. The Multiplicand, or Number to be multiplied.
   2. The Multiplier, or Number by which it is multiplied.
   3. The Product made by the Multiplication.

Example.

792 Multiplicand
32 Multiplier.
1584
2376
25344 Product.

Before you can make any progreſs in this Rule, you muſt perfectly get the following Table by Heart.

Multiplication Table.

	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81

The Uſe of the foregoing Table.

Note; That on the Top and left ſide are placed the 9 Digits, which are to be multiplied one by another; and in the common Angle of meeting, you will have the Product.

Exam-

Example.

Suppoſe I would multiply 7 times 9; look on the left-ſide of the Table for 7, and on the top of the Table for 9, and in the Angle of meeting (in the Column next the right-hand) you will find 63, the Anſwer of the Queſtion.

Queſtion 1.

Suppoſe there are 1700 private Seamen in a Squadron of Ships, and they have 23 Shillings *per* Month; How much Money will pay them for one Month? Set your Numbers thus, the greater Number uppermoſt.

1700 Multiplicand.
23 Multiplier.
5100
3400
39100 Shillings, the Anſwer of the Queſtion.

The Numbers being plac'd as is before directed, begin thus, and ſay, 3 times 0 is 0, ſet that under the 3, and proceed to the next Figure in the Multiplicand, and ſay again, 3 times 0 is 0; then ſet that 0 under the 2, and proceed to the next, and ſay 3 times 7 is 21; ſet down the 1 under the 7, and bear 2 in Mind, and proceed to the next Figure in the Multiplicand, and ſay 3 times 1 is 3, and 2 that I carry is 5, ſet that down under the 1; then have you done with the firſt Product: Then go to the next Figure in the Multiplier, and proceed as you did before, and the ſecond Product will be 3400, which muſt be ſet down under the other, only with this Caution, to move it one place more to the left-hand, as you may ſee in the Work: then add theſe two Numbers together, and the Product will be 39100, which are Shillings, the whole Sum of the Wages for 1700 Men for one Month.

Example 2.

In 235 Degrees, How many Minutes? Multiply the Degrees by 60, the Number of Minutes in one Degree.

235
60
14100 Minutes.

Note; For a Contraction in this Rule, if any Number is given to be multiplied by 10, 100, or 1000, it is but adding ſo many Cyphers to the Number given, and that will be the Product. As thus,

If 232 be multiplied by 10, it will produce 2320; by 100, 23200; by 1000, it will be 232000, *&c.*

SECT. VI.

Of DIVISION.

D*iviſion* teacheth to find how many times a leſſer Number is contained in a greater, and ſhewing what remains, ſupplying the uſe of many Subtractions. It conſiſts of three Parts, Dividend, Diviſor, and Quotient: The Dividend is the Number to be divided: The Diviſor is the Number to divide by, which is always leſſer than the Dividend. The Quotient is the Sum produced, by ſhewing how many times the Diviſor is contained in the Dividend. And if any thing happen to remain, it is called the Remainder.

Example 1.

```
            Dividend.
   Diviſor 4)250(62 Quotient.
             24
           -------
             10
              8
           -------
              2 Remainder.
```

Suppoſe 4684 ℔. is to be divided amongſt 54 Men; how much will each Man's Share come to?

Set your Numbers in order as you ſee in the following Work, (which is the eaſieſt Way of Diviſion in my Opinion) to prevent ſcratching of the Figures, and it will ſtand thus.

Example 2.

```
        Dividend.
                     lb.
Diviſor 54)4684(86 Quotient.
           432
           ---
           364
           324
           ---
            40
            20   The Shillings in one Pound, to reduce the
           ---           Remainder into Shillings.
        54)800(s.
           54  14
           ---
           260
           216
           ---
            44
            12   The Pence in a Shilling, to reduce the Remaind-
           ---           er into Pence.
            88
           44
           ---
        54)528(d.
           486 9
           ---
            42
             4   The Farthings in a Penny, to reduce it into
           ---           Farthings.
        54)168(qs.
           162 3
           ---
             6
```

So that if 4684 lb. is to be divided amongſt 45 Men, there is coming to each Man's Share 86 lb. 14 *s.* 9 *d.* 3 *qs.* as doth appear by the Work.

Note; That the beſt Proof of Diviſion is by Multiplication (thus,) Multiply the Quotient by the Diviſor, and add the Remainder (if any be); and if the Product be the ſame with the Dividend, then is the Work right, otherwiſe there is ſome Miſtake.

SECT. VII.

Of the Rule of THREE.

THe *Rule of Three* (for its excellent Uſe called the *Golden Rule*) which teaches from three Numbers given, to find a fourth in proportion

portion thereunto, which is done by multiplying the ſecond and third Numbers together, and dividing the Product by the firſt; and the Quotient of the ſaid Diviſion is the Anſwer of the Queſtion.

As if 25 Tuns of Wine coſt 800 ℔. What ſhall 35 Tuns coſt?

Here *Note*; That the firſt Number and the third muſt always be of the ſame Denomination. As if one be Pounds, Pence, Yards, Tuns, Hours, Men, *&c.* ſo reſpectively muſt the other be: and the like is to be underſtood by the ſecond and the fourth, as in the following Numbers, which are thus diſpoſed.

Tuns *Pounds* *Tuns.*
25 ———— 800 ———— 35

This Rule is performed (after an apt diſpoſal of the Terms) by *Multiplication* and *Diviſion.* But note that this Rule hath two Varieties, viz. *Direct* and *Reverſe.* Now for the proper diſpoſing the Terms in any Queſtion propounded, it is neceſſary to give a general Rule to know whether the Queſtion muſt be wrought by the direct Rule, or the Reverſe; which is this: When in the Queſtion more requires more, or leſs requires leſs: As in this Queſtion;

If 25 Tuns of Wine coſt 800 ℔. What will 35 Tuns coſt? Here it is evident that the third Term is more than the firſt, and therefore requires more. So in this Queſtion;

If 750 ℔. give 45 ℔. Intereſt for a Year, What ſhall 50 ℔. give? Here 'tis plain that 50 ℔. is leſs than 750 ℔. and requires leſs Intereſt. Therefore both theſe, and all ſuch like Queſtions, muſt be wrought by the Rule of Three Direct, wherein the Rule is plainly thus: Multiply the ſecond Number by the third, and divide by the firſt, the Quotient ſhall be the fourth Number ſought. As in the firſt of theſe Examples, multiply 800 by 35, and the Product is 28000; which being divided by 25, the Quotient is 1120 ℔. which ſhews that 35 Tuns will coſt 1120 ℔.

The Operation.

```
Tuns        ℔          Tuns       ℔.
25————800————————35  Anſw. 1120.
          35
        ————
        4000
       2400
     ————————
25)28000(1120 ℔.
   25
  ——————
    30
    25
   ————
     50
     50
   ————
      0
```

And ſo in the ſecond *Example:* Multiply 50 by 45, it makes 2250, which divided by 750, the Quotient is 3; which ſhews that the Intereſt of 50 ℔. for a Year is 3 ℔.

The Operation.

```
℔        ℔        ℔.
750——————45——————50
         50
      ————————
75|0)  225|0   (3 ℔.
```

The Rule of Three Reverſe is to be uſed, when in the third Number more requires leſs, or leſs requires more; and then the Rule is thus:

Multiply the firſt Number by the ſecond, and divide the Product by the third, the Quotient ſhall be the fourth Number ſought, which always (as in the direct Rule) ſhall be of the ſame Denomination with the ſecond Number. For Inſtance;

If 24 Pioneers require 16 Months to dig a Retrenchment about a Town; How many Pioneers muſt there be employed to dig the like Trench in 4 Months?

In ſtating this Queſtion you muſt note, That 24, though it be the firſt named, is not to be the firſt Number in the Work, becauſe the middle Term muſt always be of the ſame Denomination with that which is ſought. And the three Numbers put in order ſtand thus:

```
Months      Pioneers      Months.
16————————————24————————————4
```

Here 'tis plain leſs requires more, that is leſs Time more Hands: Therefore it muſt be wrought by the Rule Reverſe, and accordingly you may multiply 24 by 16, and divide the Product by 4, the Quotient is 96; as doth appear by the Work: which is, that 96 Pioneers muſt be employed to finiſh the Trench in 4 Months.

The Operation.

Months. Pioneers. Months.
16 ———— 24 ———— 4
16
———
144
24
———
4)384(96 Pioneers.
36
———
24
24
———
0

SECT. VIII.

Some Queſtions anſwered, and the Way of working them directed, ſerving to illuſtrate the foregoing Rule.

In ADDITION.

Queſt. An antient Lady being demanded, how old ſhe was? To avoid a direct Anſwer, ſaid thus, I have 9 Children, and there were three Years between the Birth of every one of them, my Eldeſt was born when I was 19 Years old, which is now exactly the Age of my Youngeſt. How old now is this Lady?

Anſw. It is reſolved by *Addition* thus: Firſt, Set down her Age when her firſt Child was born, which was 19, then the Difference between that and the Birth of her Youngeſt which is 24, and then the Age of the Youngeſt 19; which being added together, ſhews the Lady to be 62 Years of Age.

19 Her Age.
24 Difference between the Children.
19 Age of her Youngeſt.
———
62 Lady's Age.

In

In SUBTRACTION.

Queſt. In the Year of our Lord 1588, was the Spaniſh Invaſion; In the Year 1695, I demand how long it is ſince?

Anſw. Subtract 1588 out of 1695, there remains 107, the Time ſince (to the Year 1695.)

In MULTIPLICATION.

Queſt. How many Statute-Miles are there in the Circumference of the Body of the Earth, whoſe Circuit is 360 Degrees, and each Degree contains (according to Vulgar Computation) 60 Miles?

Anſw. Multiply 360 Degrees by 60, (the Miles contained in one Degree) and the Product is 21600 Miles.

The Operation.

```
  360
   60
 -----
21600
```

In DIVISION.

Queſt. If the Circuit of the Terreſtrial Globe is 21600 Miles; Suppoſe a Man travel continually in a direct Line (under one of the Greater Circles of the Sphere) 15 Miles a Day: In how many Days can he compaſs it?

Anſw. Divide 21600 by 15, your Quotient will be 1440, which ſhews that in ſo many Days he may effect it; that is in ſomewhat leſs than 4 Years.

The Operation.

```
15)21600(1440
   15
   --
    66
    60
    --
     60
     60
     --
     00
```

In the Rule of THREE.

Queſt. A Man lent me 400 ℔. for 7 Months, without Intereſt: How much muſt I lend him for 12 Months to retaliate his Kindneſs?

Anſw. This muſt be ſolved by the Reverſe Rule of *Three*, and muſt be thus ſtated.

Months. ℔. *Months.*
7———400———12

Where 'tis plain that more requires leſs; that is, though the third Number be more than the firſt, yet it requires a leſſer Number to anſwer unto it than the ſecond. Therefore you muſt multiply 400 by 7, and it is 2800, which divided by 12 (the third Number) makes 233 ℔. and 4 ℔ remaining, the 12 part of which is 6 *s.* 8 *d.* So the Anſwer to the Queſtion is, That I muſt lend him 233 ℔. 6 *s.* 8 *d.* for 12 Months.

The Operation.

Months ℔. *Months.*
7———400———12
7
12)2800(233
24
40
36
40
36
4 Which being reduced by 20 the Shillings in one Pound, and it is 80 Shillings; which being divided by 12, produceth 6 *s.* and 8 remaining, which is $\frac{8}{12}$ of a Shilling, or 8 Pence.

The Operation.

20
4
12)80(6 *s.*
72
8

CHAP.

CHAP. II.

Containing ſundry uſeful Definitions and Problems of GEOMETRY.

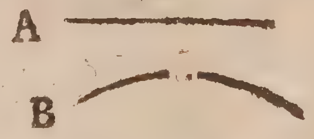
SECT. I.

Geometrical Definitions.

A *Point* is that which cannot be divided, having neither Part nor Quantity, and therefore void of Length, Breadth or Depth; and is repreſented in the Margin, by the Letter A.

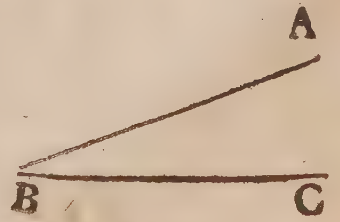
A,

A *Line* is Length without Breadth or Thickneſs, and is Right, as A; Or Curved, as B.

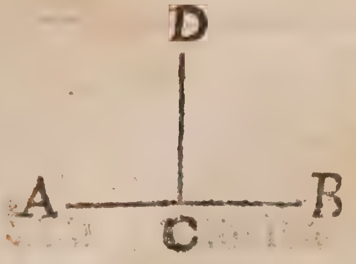


An Angle is the Inclination of two Lines one to another, the one touching the other, yet not ſo as to make one Line; as the Lines B A and B C.

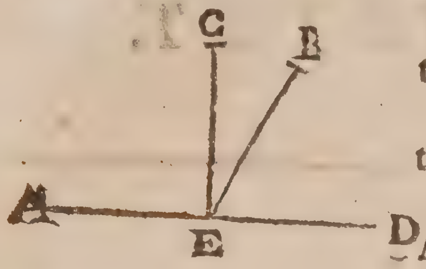
A *Right-lin'd-Angle*, is that which is contained by right Lines, as the Angle A B C.



A *Right-lin'd-Angle*, is either Right, or Oblique.



A *Right-Angle* is when a Right-Line, ſtanding upon a Right Line, makes the Angles on each ſide equal to each other; as the Right-Angles A C D, and B C D.

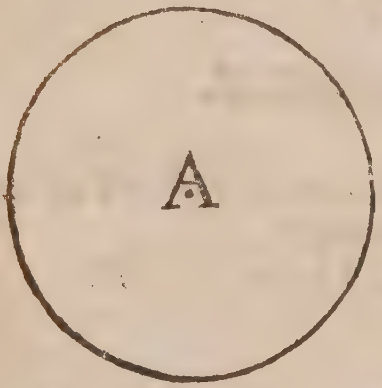


An *Oblique-Angle* is either Acute or Obtuſe.

An *Acute-Angle* is leſs than a Right, as the Angle D E B.

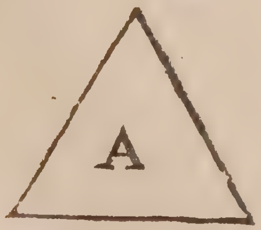
An *Obtuſe-Angle* is greater than a Right-Angle, as A E B.

A *Plain-Figure* is contained under one Term, or more.



A *Circle* is a Plain Figure contained under one Term or Line, called *the Circumference*, unto which all Lines drawn from a certain Point within the Figure are equal; and that Point is called the Center, as A.

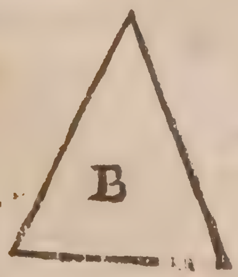
A *Right-lin'd Figure* is contained by Right-Lines, and is either three-ſided, four-ſided, or many-ſided.



A *Triangle* is a three-ſided Figure, and is conſidered either in reſpect of its Sides, or Angles.

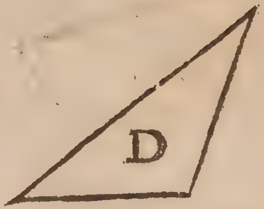
In reſpect of its Sides, 'tis either,

Equilateral, having three equal Sides; as A:



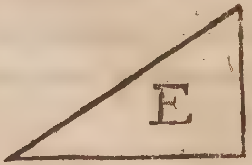
Or *Equicrural*, having two equal Sides; as B.

Or *Scalenum*, having three unequal Sides; as D.

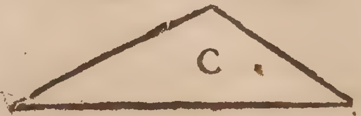


In reſpect of its Angles, 'tis either,

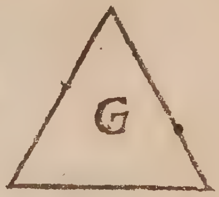
Right-angled, which hath a Right-Angle; as E.



Or *Oblique-angled*, which hath no Right-Angle, but hath two Acute-Angles and one Obtuſe-Angle; as C.

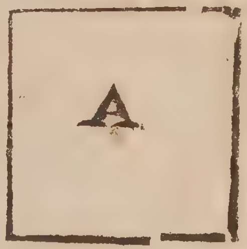


Or three *Acute-Angles*; as G.

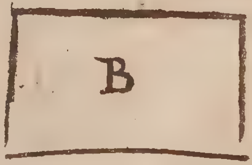


Of four-ſided Figures.

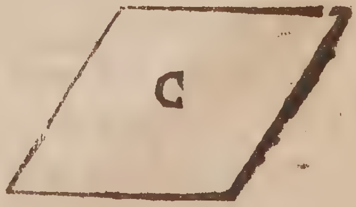
A *Square* is that which hath four equal Sides and four Right-Angles; as A.



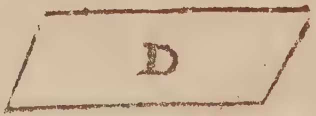
An *Oblong* hath four Right-Angles, and the oppoſite Sides equal; as B.

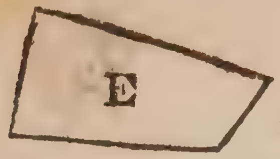


A *Rhombus* hath four equal Sides, but is not Right-angled; as C.

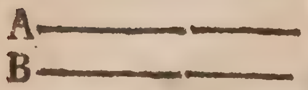


A *Rhomboides* hath the oppoſite Sides and Angles equal, but is neither equal-ſided nor Right-angled; as D.





All other four-ſided Figures are called *Trapezia's*, as E.

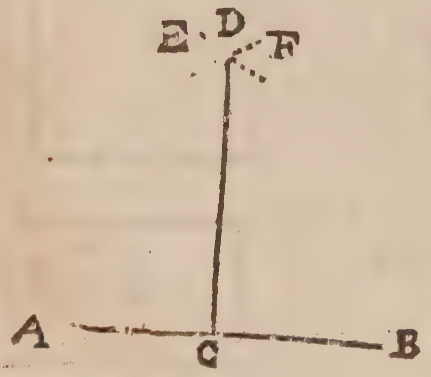


Parallel, or equi-diſtant Right-Lines are ſuch, which being in the ſame Superficies, if infinitely produced, would never meet, as A and B.

SECT. II.

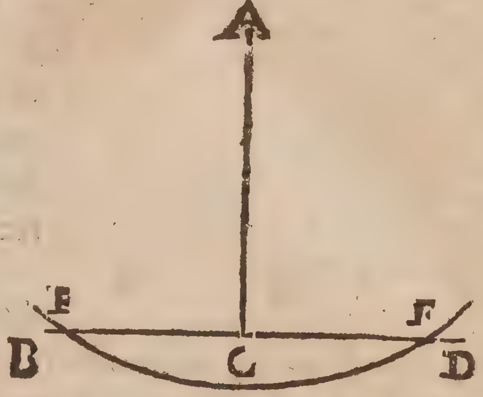
Geometrical Problems.

How to raiſe a Perpendicular on the middle of a given Line.



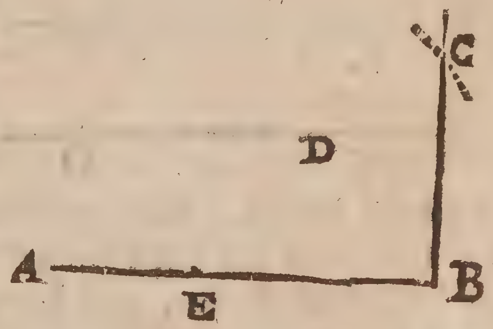
LET the given Line be A B, and C be a Point therein, whereon it is required to raiſe a Perpendicular. Firſt, open the Compaſſes to any convenient diſtance, and ſetting one foot in the point C, with the other ſet off on either ſide thereof the equal Diſtances, C A and C B: Then opening the Compaſſes to any convenient (wider) diſtance, ſetting one foot in the Point A, with the other ſtrike the occult Arch at F; then with the ſame diſtance ſet one foot in the point B, and with the other draw the Arch E, croſſing F in the point D, from whence draw the Line D C, which Line is a Perpendicular unto the given Line A B, as was required.

To let fall a Perpendicular from a Point aſſigned, to the Middle of a given Line.



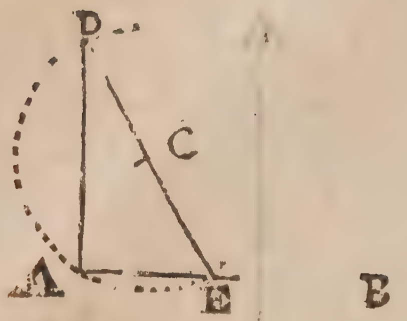
Let B C D be the given Line, and A the point aſſigned, from whence you would have a Perpendicular let fall: Firſt ſet one foot of your Compaſſes in the Point A, and opening them to any convenient Diſtance, deſcribe an Arch of a Circle that it may cut the Line B C D at E and F; then find the Middle between E and F, which will be the Point C, from which point draw the Line A C, which is the Perpendicular Line required.

To raiſe a Perpendicular upon the End of a Line given.



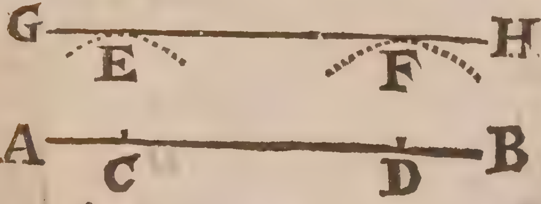
Let the given Line be A B; then Firſt, open your Compaſſes to a convenient diſtance, and ſet one foot in the point B, and let the other point fall any where above the Line, as at the point D; and in that point let one foot of your Compaſſes remain, turning the other about, until it touch the Line A B in the Point E; then turn the foot of the Compaſſes towards C, and draw an occult Arch, and lay the edg of a Ruler to thoſe points E and D; and where the ſame edg of the Ruler doth cut the Arch C, from that point draw the Line C B, which ſhall be a Perpendicular at the end of the Line A B, as was required.

To let fall a Perpendicular from a Point aſſigned, unto the End of a Line given.



Let the Line A B be given, unto which it is required to let fall a Perpendicular from the Point D, unto the End A. Firſt, from the Point D draw a Line unto any part of the given Line A B, which may be the Line D C E; find the middle of the Line, which is at C, place one foot of your Compaſſes in that Point, and extend the other unto D or E, with which Diſtance deſcribe the Semi-Circle D A E, which ſhall cut the given Line A B in the Point A; from which Point draw the Line D A, which is the Perpendicular, on the End of the given Line A B, as was required.

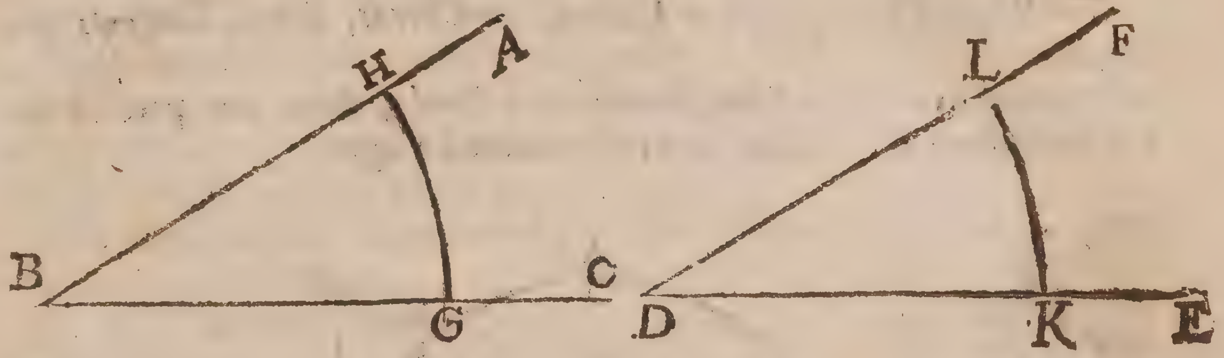
To draw a Line Parallel to a Line given,



Let A B be a Line given, whereunto it is required to draw a Parallel. Firſt, ſet one foot of your Compaſſes in the Point C, and opening the other at pleaſure, draw the Arch E; then with the ſame Diſtance ſet one Foot in the Point D, and draw the other Arch F: Laſtly, lay a Ruler to the Convexities of both thoſe Arches, and draw the Line G H, which ſhall be a Parallel to A B, as was required.

How to make an Angle equal to an Angle given.

Let A B C be the given Angle, draw the Line D E, and upon B as a Center, deſcribe the Arch G H, between the Sides B A and B C; and upon the Point D, with the ſame Extent deſcribe the Arch K L, and place the Extent G H from K to L; then through the Point L draw D F: So is the Angle E D F equal to A B C, which was required.



CHAP. III.

Treateth of the Doctrine of Plain or Right-lin'd Triangles.

SECT. I.

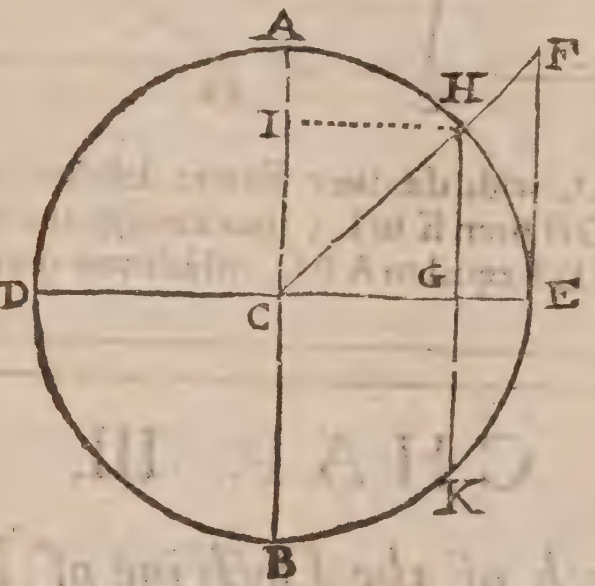
Containing ſome Things neceſſary to be underſtood, relating to the Science *of* Plain Trigonometry.

THE *Doctrine of Triangles* is converſant in the *Menſuration of Triangles, Plain* or *Spherical*, comparing the Sides and Angles together, according to known Analogies; whereby three Things being given, either Sides, Angles, or both, a fourth Side or Angle may be found.

But becauſe the Angles of both Plain and Spherical-Triangles are meaſured by Arches of Circles, and the Sides likewiſe of Spherical-Triangles are themſelves Arches of great Circles, therefore theſe Arches are in a manner *reduced into the Right-Lines applied thereunto.*

The Right-Lines applied to Circles, are *Chords*, *Sines*, *Tangents* and *Secants*.

A *Chord* is a Right-Line drawn in a Circle, from one part of the Circumference to the other, as in the annexed Figure.



H K is the Chord of the Arches H E K, and H D K; alſo D E the Diameter, is the Chord of the Semi-Circles D A E and D B E.

The right Sine of an Arch is half the Chord of twice that Arch, as H G being half the Chord H K, is the right Sine of the Arch H E; alſo of the Arch H A D, the Arch H E being the half of H E K, and the Arch H A D being half the Arch H D K. The Sine Complement of the Arch HE is H I, equal to C G.

The Verſed Sine of an Arch, is that Part of the Diameter which lieth between the right Sine of that Arch and the Circumference, ſo that G E is the Verſed Sine of the Arch H E, and G D the Verſed Sine of the Arch H A D.

The Tangent of an Arch, is a Right-Line touching the Arch, being perpendicular to the Radius drawn to the Point of Contact, and concurring with a Line drawn from the Center, through the Term or End of that Arch; ſo EF is a Tangent of the Arch E H.

A Secant is that Right-Line drawn from the Center of the Arch, until it meet with the Tangent; So C F is a Secant of the Arch E H.

It is to be underſtood that every Circle is divided into 360 equal Parts, called Degrees; every Degree into 60 Parts, called Minutes; and every Minute into 60 Parts, called Seconds, *&c.*

The Complement of an Arch or Angle, is commonly the Complement thereof to (or that which makes it up) 90 deg. But if it be meant the Complement thereof to a Semi-Circle, it is expreſſed by ſaying the Complement to 180 deg.

A Plain-Triangle is contained under three Right-Lines, and is either Right-angled or Oblique.

In all Plain-Triangles, two Angles being given, the third is alſo given: and one Angle being given, the Sum of the other two is alſo given, becauſe the three Angles together are equal to two right Angles.

Therefore in a Plain Right-angled Triangle, one of the acute Angles is the Complement of the other to 90 deg.

In the Solution of Plain Triangles, the Angles being only given, the Sides cannot be found, but only the reaſon of the Sides: It is therefore neceſſary that one of the Sides be known; As,

In a Right-angled Triangle two things (beſides the Right-Angle) will ſerve to find the third, ſo one of them be a Side.

In oblique-angled Triangles, there muſt be three things given (one of them being a Side) to find a fourth.

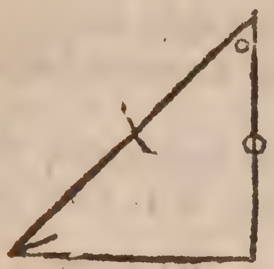
Some Symbols uſed in the Doctrine of Triangles for Brevity's ſake.

= Equal to.
+ More.
− Leſs.
x Multiplied by, or drawn into.
° Over a Number ſtands for Degrees, as 12° ſignifies 12 deg.
′ Signifies Minutes, as 12′ is 12 Minutes.
cr. A Side. crs. Sides.
V An Angle. VV Angles.
Z The Sum.
X The Difference.
S Sine.
Sc. Co-Sine, or Sine Complement.
Co. Ar. Complement Arithmetical.
t Tangent.

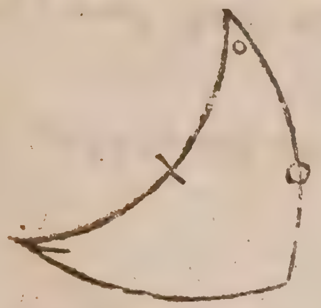
tc. Co-Tangent, or Tangent Complement.
2 R Ang. Two Right-Angles.
Q Square.

In Right-angled Plain Triangles, the Sides comprehending the Right-Angle are called the *Legs*; and the Side ſubtending (or oppoſite to) the Right-Angle, is called the *Hypotenuſe*.

In the Doctrine of Triangles, three Letters denote an Angle, as B A C ſignifies the Angle at A; A C B the Angle at C. Two Letters ſhew a Side, as Side A B, or A C.



In the Doctrine of Triangles the given Sides or Angles are noted with a Daſh, thus, (')



The required Sides or Angles with a Cipher, thus, (o)

In Right-angled Plain Triangles, there are ſeven Caſes, and in Oblique Triangles five: For the Solution of which, theſe four *Axioms* are ſufficient.

Axiom 1.

Of Right-angled Triangles.

In all plain Right-angled Triangles, any of the Sides may be made Radius; and the other Sides will be Sines, Tangents or Secants: and what Proportion the Side put for Radius, hath to Radius; the ſame Proportion have the other Sides, to the Sines, Tangents, and Secants by them repreſented.

Axiom 2.

Of Oblique Triangles:

In all Plain Triangles, the Sides are in ſuch proportion one to another, as the Sines of their oppoſite Angles.

Axiom 3.

In all Plain Triangles; As the Sum of two Sides is to their Difference, ſo is the Tangent of the half Sum of their two oppoſite Angles, to the Tang. of the Difference of either of them, above or under the half Sum.

Axiom 4.

In all Plain Triangles; As the Baſe is in Proportion to the Sum of the other Sides, ſo is the Difference of theſe Sides, to the Difference of the Segment of the Baſe.

SECT. II.

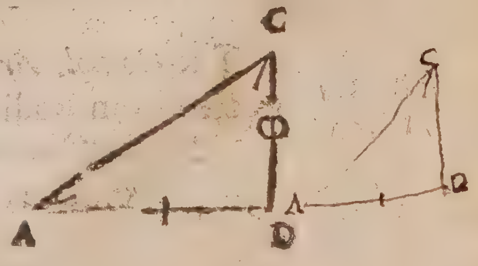
Of Right-angled Plain Triangles.

Caſe I.

THE Angles, and one of the Legs given, to find the other Leg.

Example.

In the Triangle A B C,
There is given
B A C 33° 45′ } BC required.
A B, 90



The Operation by the Logarithms.

As S. ACB 56° 15′ Log.	9.91984
To AB 90	1.95424
So is S. BAC 33° 45′	9.74474
	11.69898
To BC required, 60	1.77914

The General Rule for working Proportions by the Logarithms.

Add the Logarithms of the ſecond and third Numbers together; From that Sum ſubtract the Logarithm of the firſt, and the Remainder is the Logarithm of the fourth Number ſought; as is apparent by the precedent Operation.

Note; That the Work may be abbreviated in this and the following Caſes: When Radius is not in the Proportion, then take the Complement Arithmetical of the firſt Logarithm, and then adding the Logarithms of the ſecond and third, and the Complement Arithmetical of the firſt into one Sum, from which bating Radius, (or an Unit towards the Left-hand) the Remainder is the Logarithm of the fourth Number.

The Operation by the Compl. Arith.

	Co. Ar.
As S. ACB 56° 15′ Log.	0.08016
To AB 90	1.95424
So is S. BAC, 33° 45′	9.74474
To BC required, 60	11.77914

The *Compl. Arith.* of a Log. is the Remainder thereof, being ſubtracted from Radius.

So the Compl. Arith. of S. 56° 15′	10.00000
is 0.08016, as here appears:	9.91984
	0.08016

But a readier way is hinted by Mr. *Norwood*, thus: By taking the Compl. or Reſidue of the firſt Figure towards the Left-hand unto 9, and ſo of the reſt, until you come to the laſt Figure towards the Right-hand, thereof ſet down the Reſidue to 10, thus, To take the Compl. Arith. of 9.91984. For 9 I write his Reſidue unto 9, which is 0; for 9, 0; for 1, 8; for 9, 0; for 8, 1; for 4, the Compl. to 10, which is 6. And ſo I have 0.08016, which is the Compl. Arith. of 9.91984.

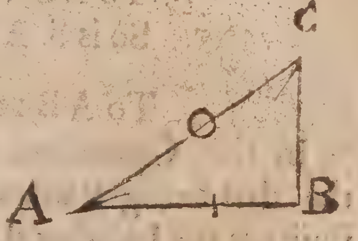
How to work this and the following Caſes by *Gunter*'s Scale, ſhall be ſhewn in the Uſe of that Inſtrument.

Caſe II.

The Angles, and one of the Legs given, to find the *Hypotenuſe.*

Example.

In the Triangle A B C,
There is given,
A C B 56° 15′ } A C required.
A B 90



The Operation.

As S. A C B 56° 15′ Log. ——— 9.91984

To A B 90 ——— 1.95424
So is Radius ——— 10.00000

To A C required, 108 ——— 2.03440

In the Operation of this Caſe, there is no need to take the Compl. Arith. becauſe Radius is one of the four Terms in the Proportion; nor of adding the Logs. of the ſecond and third together, according to the general Rule aforegoing; only ſubtract the former Figures of the firſt Log. from the ſecond Log. And in ſubtracting the laſt Figure of the firſt Log. add 10 to the correſponding Figure of the ſecond Log, *viz.*

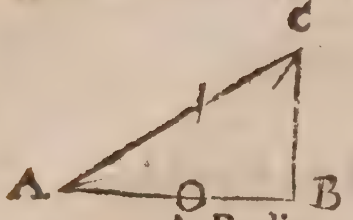
Say, 9 from 11, there remains 2; This Remainder 2.03440, gives the Log. of the fourth Number required.

Caſe III.

The Angles and *Hypotenuſe* given, to find either of the Legs.

Example.

In the Triangle A B C,
There is given
A C B 56° 15′ } A B required.
AC 108 }



The Operation.

As Radius——————————— 10.00000

To AC 108——————————— 2.03342
So is S. A C B 56° 15′ ——————————— 9.91984

To A B required, 89 ——————————— 21.95326

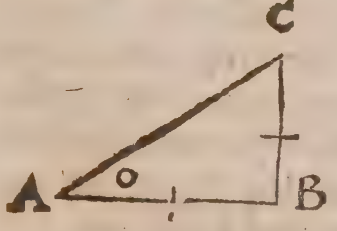
In this Operation the ſecond and third Log. being added together, the firſt being Radius is eaſily ſubtracted, by cutting off the laſt Figure towards the Left-hand, as is evident in the Example.

Caſe IV.

The Legs given, to find the Angles.

Example.

In the Triangle A B C,
There is given
A B 90 } B A C required.
B C 60 }



The Operation.

As A B, 90——————————— 1.95424

To Radius——————————— 10.00000
So is B C 60——————————— 1.77815

To t. B A C required, 33° 41′——————————— 9.82391

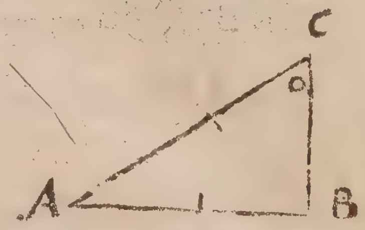
This Operation is performed as the Example in the ſecond Caſe before-going.

Caſe V.

Caſe V.

The *Hypotenuſe*, and one of the Legs given, to find the Angles.

Example.



In the Triangle A B C,
There is given,
A C 108 } A G B required.
A B 90 }

The Operation.

As A C 108 ———————————— 2.03342

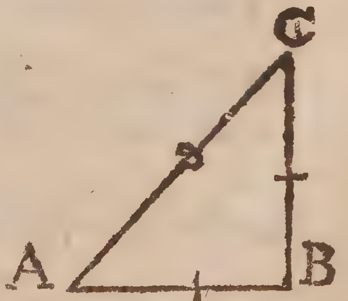
To Radius ———————————— 10.00000
So is A B 90 ———————————— 1.95424

To S. A C B required, 56° 26′ ———————— 9.92082

This is performed as the precedent Operation in the fourth Caſe.

Caſe VI.

The Legs given, to find the *Hypotenuſe*.



In the Triangle A B C
There is given,

A B 90 } A C required.
B C 60 }

This Caſe requires a double Operation.

1. By the *4th* Caſe to find the Angles.
2. By the ſecond Caſe to find the *Hypotenuſe*.

The firſt Operation.

As A B, 90 ——— 1.95424

To Radius ——— 10.00000
So is B C, 60 ——— 1.77815

To t. B A C 33° 41′ ——— 9.82391

The ſecond Operation.

As S. B A C 33° 41′ ——— 9.74398

To B C 60 ——— 1.77815
So is Radius ——— 10.00000

To A C required, 108 ——— 2.03417

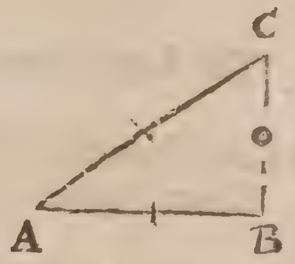
Caſe VII.

The *Hypotenuſe*, and one of the Legs given, to find the other Leg.

Example.

In the Triangle A B C,
There is given,

A C 108 } B C required.
A B 90 }



This Caſe likewiſe requires a double Operation.

1. By the 5*th* Caſe to find the Angles.
2. By the 1*ſt* or 3*d* Caſe, to find the Leg required.

The firſt Operation.

As A C 108 ——— 2.03342

To Radius ——— 10.00000
So is A B 90 ——— 1.95424

To S. A C B 56° 26′ ——— 9.92082

The

The ſecond Operation.

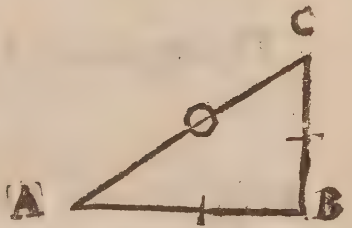
As Radius ——————————— 10.00000
To A C 108 ——————————— 2.03342
So is S. B A C 33° 34′ ——————— 9.74265
To B C required, 59 ————————— 11.77607

The ſixth and ſeventh Caſes before-going, may be performed without the Canon of Sines and Tangents, by the 46 Prop. 1. *Euclid. viz.* That in Plain Right-angled Triangles, the Square of the *Hypotenuſe* is equal to the Sum of the Squares of the two Legs.

Example of the Sixth Caſe.

In the Triangle A B C
There is given,

A B 90 } A C required.
B C 60 }



Square the given Legs ſeverally, add their Squares together, the Square-Root of that Sum is the *Hypotenuſe* required.

The Operation.

A B 90 BC 60 the Square of A B 8100
90 60 the Square of B C 3600

00 00 11700 (108 A C requ.
810 360 1

Square 8100 Square 3600 20) 17
00

208) 1700
1664

36

Otherwiſe by the Logarithms.

From the double Log. of the greater Leg, ſubtract the Log. of the leſs, and to the abſolute Number anſwering to the Difference of the Logs. add the leſs Leg; half the Sum of the Logs. of the ſaid Sum and leſs Leg, is the Log. of the *Hypotenuſe* required.

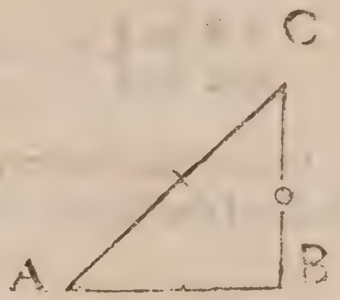
The Operation.

The greater Leg A B, 90 Log.	1.95424
The ſame again,	1.95424
The doubled Log.	3.90848
The leſs Leg B C 60 Log. ſubtr.	1.77815
The abſolute Number 135	2.13033
The Sum 195 Log.	2.29003
Leſs Leg B C 60 Log.	1.77815
Sum	4.06818
The *Hypotenuſe* A C 108 ½ Sum	2.03409

Example of the Sixth Caſe.

In the Triangle A B C,
There is given

A C 108 } B C required.
A B 90 }



From the Square of the *Hypotenuſe*, ſubtract the Square of the given Leg, the Square Root of the Remainder is the Leg required.

The Operation.

A C 108	A B 90	the Square of A C 11664
108	90	the Square of A B 8100
864	00	Remainder 3564(59
1080	108	25
Squ. 11664	Square 8100	109) 1064
		981
		83

Otherwiſe by the Logarithms.

Half the Sum of the Logs. of the Sum, and of the Difference of the *Hypotenuſe* and given Leg, is the Log. of the Leg required.

The Operation.

The *Hypotenuſe* A C	108		
The given Leg A B	90		
The Sum	198	Log.	2.29666
The Diff.	18	Log.	1.25527
		Sum	3.55193
The Leg B C 59 required,		½ Sum	1.77596

S E C T. III.

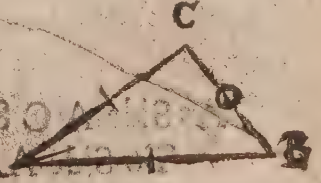
Of Oblique-angled Plain Triangles.

Caſe I.

THE Angles and one of the Sides given; to find one of the other Sides.

Example.

In the Triangle A B C,
There is given
B A C 33° 45′
A B C 45 00 } B C required.
A C 40



The Operation of this and the following Caſe, depends upon the ſecond *Axiom* aforegoing.

The Operation.

	Co. Ar.
As S. A B C 45° 00′	0.15052
To Side A C 40	1.60206
So is S. B A C 33° 45′	9.74474
To Side B C required, 31	~~1~~1.49732

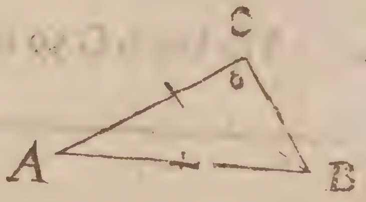
After the ſame manner you might find the Side A B if it were required.

Caſe II.

Two Sides, and an Angle oppoſite to one of them, being given, to find the other oppoſite Angle.

Example.

In the Triangle A B C,
There is given
A B C, 45° 00′
A B 100
A C 80
} A C B required, being obtuſe.



1. In this caſe, If the given Angle be obtuſe, the Angle required is Acute.

2. If the given Angle be Acute, and oppoſite to the greater of the given Sides, the required Angle is Acute.

3. If the given Angle be Acute, and oppoſite to the leaſt of the given Sides, it's doubtful whether the Angle ſought be acute or obtuſe, and ought to be determined before the Operation; as in this Example.

The Operation.

	Co. Ar.
As Side A C 80	8.09691
To Side A B C 45° 00′	9.84948
So is Side A B 100	2.00000
To S. A C B required, 117° 54′	19.94639

In this Operation is produced the Log-Sine of 62° 6′ for the Angle ſought; but becauſe it is Obtuſe, you muſt take its Complement to 180°, *viz.* 117° 54′.

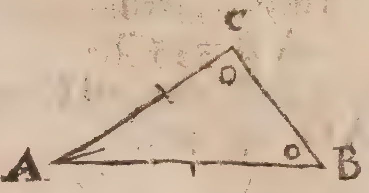
Caſe III.

Two Sides, and their contained Angles given, to find the other Angles.

Example.

Example.

In the Triangle A B C,
There is given,
A B 25
A C 20
B A C 33° 45′ } A C B and A B C required.



The Operation of this Caſe depends upon the third *Axiom.*

The Operation.

The Side A B 25 — 180° 00′
The Side A C 20 — B A C 33 45
The Sum of the Sides 45 — Sum 146 15
Their Difference 05 — $\frac{1}{2}$ Sum 73 07 of the unknown Angles.

		Co. Ar.
As the Sum of the Sides A B and A C 45 Log.		8.34679
To their Difference,	5	0.69897
So is t. $\frac{1}{2}$ Sum of the oppoſite Angles	73° 07′	10.51783
To t. of their half Difference	20 06	19.56359

The half Difference added to the half Sum, gives the greater Angle; and ſubtracted, leaves the leſs.

The $\frac{1}{2}$ Sum of the Angles 73° 07′
The $\frac{1}{2}$ Difference 20 06
Added, gives A C B 93 13
Subtracted, A B C 53 01

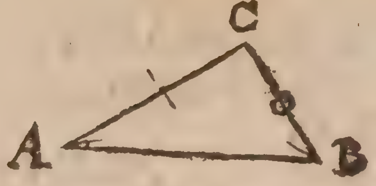
Caſe IV.

Two Sides, and their contained Angle given; to find the third Side.

Example.

Example.

In the Triangle A B C,
There is given
A B 335
A C 271 } B C required.
B A C 14° 40′



This Caſe requires a double Operation.
1. By the 3*d* Caſe to find the Angles.
2. By the 1*ſt* Caſe to find the Side required.

The firſt Operation.

		Co. Ar.
As the Sum of the Sides A B and A C	606 Log.	7.21753
To their Difference,	64	1.80618
So is t. ½ Sum Angles	82° 40′	10.89044
To t. ½ their Difference	39 22	~~1~~9.91415

By which you will find the Angle A B C to be 43° 18′.

The ſecond Operation.

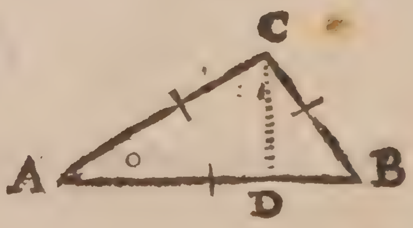
	Co. Ar.
As S. A B C 43° 18′ Log.	0.16379
To Side A C 271	2.43297
So is S. B A C 14° 40′	9.40345
To Side B C required, 100	~~1~~2.00021

Caſe V.

Three Sides given, to find an Angle.

Example.

In the Triangle A B C,
There is given,
A B 64
A C 47 } B A C required.
B C 34



The Reſolution of this Caſe depends upon the 4*th Axiom*, reducing the Oblique-angled Triangle into two Right-angled Triangles, by letting fall the Perpendicular C D, upon the Baſe greater Side A B, and requires a double Operation.

The Baſe is that Side upon which the Perpendicular falls.

1. To find the Segment of the Baſe A D.
2. To find (by the 5*th* Caſe of Rectangulars) the Angle required.

The firſt Operation.

			Co. Ar.
A C 47	As the Baſe A B	64	Log. 8.19382
B C 34	To the Sum of the Sides A C and B C	81	1.90848
Sum 81	So is the Difference of the Sides A C & B C	13	1.11394
Diff. 13	To the Differ. of the Segments of the Baſe	16	11.2162

The Baſe is 64
The Difference of the Segments 16

Sum 80
$\frac{1}{2}$ Sum 40, is AD the greater Segment of the Baſe, becauſe adjacent to the greater Side A C.

The ſecond Operation.

In the Triangle A C D, Right-angled at D,
There is given A D and A C, to find C A D.

As A C, 47	Log. 1.67209
To Radius	10.00000
So is A D, 40	1.60206
To ſc. C A D 31° 40′	9.92997

CHAP. IV.

The Doctrine of Spherical TRIANGLES.

SECT. I.

Containing the Affections of Spherical Triangles, and their Axioms.

1.

A Spherical Triangle is that which is deſcribed on the Surface of the Sphere.

2. The Sides of a Spherical Triangle are the Arches of three great Circles of the Sphere mutually interſecting each other.

3. Spherical Angles are meaſured by the Arch of a great Circle, intercepted between the Sides containing the Angle, the Pole of that Circle being the Angular Point.

4. Thoſe are ſaid to be great Circles, which biſſect the Sphere.

5. Thoſe Circles which cut each other at Right-Angles, paſs through the Poles of each other, and the contrary.

6. In every Spherical Triangle, each Side is leſs than a Semi-Circle.

7. In every Spherical Triangle, any two Sides together are greater than the third.

8. The Sum of the Sides of a Spherical Triangle is leſs than two Semi-Circles.

9. If two Sides of a Spherical Triangle be equal to a Semi-Circle, the two Angles at the Baſe ſhall be equal to two Right-Angles; if they be leſs than a Semi-Circle, the two Angles ſhall be leſs;

but if greater than a Semi-Circle, the two Angles ſhall be greater than two Right Angles.

10. The Sum of the three Angles of a Spherical Triangle are greater than two Right Angles, and leſs than ſix.

11. Two Angles of any Spherical Triangle, are greater than the Difference between the third Angle and a Semi-Circle. Therefore,

12. Any Side being contained, the Exterior Angle is leſs than the two Interior oppoſite Ones.

13. In any Spherical Triangle, the Difference of the Sum of two Angles and a whole Circle, is greater than the Difference of the third Angle and a Semi-Circle.

14. In any Spherical Triangle, one Side being produced, if the other two Sides be equal to a Semi-Circle, the outward Angle ſhall be equal to the inward oppoſite Angle upon the Side produced: If they be leſs than a Semi-Circle, the outward Angle ſhall be greater than the inward oppoſite Angle: If they be greater than a Semi-Circle, the outward Angle ſhall be leſs than the inward oppoſite Angle.

15. A Spherical Triangle is either Right, or Oblique-angled.

16. A Right-angled Spherical Triangle, is that which hath one Right Angle at the leaſt.

17. The Legs of a Right-angled Spherical Triangle, are of the ſame Affection with their oppoſite Angles.

18. In a Right-angled Spherical Triangle, if either Leg be a Quadrant, the *Hypotenuſe* ſhall be alſo a Quadrant; but if both the Legs be of the ſame Affection, (that is, be both great or both leſs than a Quadrant) the *Hypotenuſe* is leſs than a Quadrant; or if of different Affections, then greater, and the contrary.

19. In a Right-angled Spherical Triangle, if either the Angles at the *Hypotenuſe* be a Right-Angle, the *Hypotenuſe* ſhall be a Quadrant; but if both ſhall be of the ſame Affection, it ſhall be leſs; if of different, it ſhall be greater, and the contrary.

20. In a Right-angled Spherical Triangle, the Sum of the Oblique-Angles are leſs than three Right-Angles.

21. An Oblique Spherical Triangle is either Acute or Obtuſe.

22. An Acute-angled Spherical Triangle, hath all its Angles Acute.

23. An Obtuſe-angled Spherical Triangle, hath all its Angles either Obtuſe or Mixt, *viz.* ſome Acute and ſome Obtuſe.

24. In any Spherical Triangle whoſe Angles are all Acute, each Side is leſs than a Quadrant.

In Spherical Triangles there are 28 Caſes, 16 in Rectangular, and 12 in Oblique-Angular. The 16 Caſes of Rectangular are reſolved by theſe two *Axioms* following.

Axiom 1.

In all Spherical Rectangled Triangles, having the ſame Acute Angle at the Baſe, the Sines of the *Hypotenuſa*'s are proportional to the Sines of their Perpendiculars.

Axiom 2.

In all Spherical Rectangled Triangles, having the ſame Acute Angle at the Baſe, the Sines of the Baſes, and the Tangents of the Perpendiculars are proportional.

That all the Caſes of a Right-angled Spherical Triangle may be reſolved by theſe two *Axioms*,

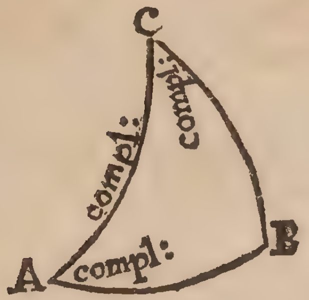
The ſeveral Parts of the Spherical Triangle propoſed, muſt ſometimes be continued to Quadrants, that ſo the Angles may be turned into Sides, the *Hypotenuſa*'s into Baſes and Perpendiculars, and the contrary. By which means the Proportions, as to the Parts of the Triangle given, inſtead of Sines do ſometimes fall in Co-Sines, and ſometimes in Co-Tangents inſtead of Tangents. Such Parts as do change their Proportion, are noted with their Complements, *viz.* the *Hypotenuſe*, and both the Oblique Angles: but the Sides containing the Right Angle do not ſo change.

Theſe are called the five Circular Parts of a Triangle, amongſt which the Right Angle is not reckoned, and therefore the two Sides which do contain it are ſuppoſed to be joined together.

Each of theſe Circular Parts may by Suppoſition be made the middle Part, and then the two Circular parts which are next to that middle Part, are the Extreams Conjunct; the other two, remote from the Part aſſumed, are the Extreams Disjunct.

As in the Triangle A B C, if Comp. A C be made the middle Part, Comp. A and Comp. C are the Extreams Conjunct, and the Sides A B and B C are the Extreams Disjunct; and ſo of the reſt, as in the Table following.

Mid.



Mid. Part.	*Extr. Conj.*	*Extr. Disj.*
Leg. A B	*Comp.* A *Leg.* B C	*Comp.* A C *Comp.* C
Comp. A	*Comp.* A C *Leg.* A B	*Comp.* C *Leg.* B C
Comp. A C	*Comp.* A *Comp.* C	*Leg.* A B *Leg.* B C
Comp. C	*Comp.* A C *Leg.* B C	*Comp.* A *Leg.* A B
Leg. B C	*Comp.* C *Leg.* A B	*Comp.* A *Comp.* A C

The Parts of a Right-angled Spherical Triangle being thus diſtinguiſhed into five Circular Parts, for the more eaſe in reſolving all Spherical Triangles, obſerve this Catholick and Univerſal Proportion, invented by the Lord *Napier*.

The Sine of the Middle-part and Radius, are reciprocally proportional to the Tangents of the Extreams Conjunct, and the Co-Sines of the Extreams Disjunct.

That is; As Radius, to the Tangent of one of the Extreams Conjunct; ſo is the Tangent of the other Extream Conjunct, to the Sine of the Middle-part.

And alſo, As Radius to the Co-Sine of one of the Extreams Diſjunct; ſo is the Co-Sine of the other Extream Disjunct, to the Sine of the Middle-part.

Therefore if the Middle-part be ſought, the Radius muſt be in the firſt place; if either of the Extreams, the other Extream muſt be in the firſt place.

Only note, That if the Middle-part, or either of the Extreams Conjunct, be noted with its Complement in the Circular Parts of the Triangle, inſtead of the Sine or Tangent, you muſt uſe the Co-Sine or Co-Tangent.

If either of the Extreams Disjunct be noted by its Complement in the Circular Part of the Triangle, inſtead of the Co-Sine you muſt uſe the Sine of ſuch Extream Disjunct.

That the Directions may be the better underſtood, there is in the Table following the Circular Parts of a Triangle under their reſpective Titles, whether they be taken for the Middle-part, or for the Extreams, whether Conjunct or Disjunct; and unto thoſe Parts there is prefixed the Sine and Co-Sine, the Tangent or Co-Tangent, as it ought to be by the Catholick Propoſition.

Mid. Part.	*Extr. Conj.*	*Extr. Disj.*
Sine A B	*Co-Tan.* A *Tan.* B C	*Sine* A C *Sine* C
Co-Sine A	*Co-Tan.* A C *Tan.* A B	*Sine* C *Co-Sin.* B C
Co-Sine A C	*Co-Tan.* A *Co-Tan.* C	*Co-Sin.* A B *Co-Sin.* B C
Co-Sine C	*Co-Tan.* A C *Tan.* B C	*Sine* A *Co-Sin.* A B
Sine B C	*Co-Tan.* C *Tan.* A B	*Sine* A *Sine* A C

Axiom 3.

In all Spherical Triangles, the Sines of the Sides are in direct proportion to the Sines of their oppoſite Angles, and the contrary.

Axiom 4.

In all Oblique-angled Spherical Triangles, in which two Sides are leſs than a Semi-Circle:

As the Sine of half the Sum of two Sides,
To the Sine of half their Difference;
So is the Co-Tangent of half the contained Angle,
To the Tangent of half the Difference of the oppoſite Angles.

And,

As the Co-Sine of half the Sum of the Sides,
To the Co-Sine of half their Difference;
So is the Co-Tangent of half the contained Angle,
To the Tangent of half the Sum of the oppoſite Angles.

Axiom 5.

In all Oblique-angled Spherical Triangles, in which two Angles are leſs than two Right-Angles:

As the Sine of half the Sum of two Angles,
To the Sine of half their Difference;
So is the Tangent of half the interjacent Side,
To the Tangent of half the Difference of the oppoſite Sides.

And,

As the Co-Sine of half the Sum of the Angles,
To the Co-Sine of half their Difference;
So is the Tangent of half the interjacent Side,
To the Tangent of half the Sum of the oppoſite Sides.

Axiom 6.

As the Rectangle of the Sines of the containing Sides,
To the Square of Radius;
So is the Rectangle of the Sines of half the Sum of the three Sides, and of the Difference of the oppoſite Side therefrom,
To the Square of the Co-Sine of half the Angle ſought.

This being premiſed, the ſeveral Caſes ſhall be ſet down, with their Analogies, and reſolved by the Logarithms.

First, Of *Right-angled Triangles.*
Then, Of *Oblique.*

SECT.

SECT. II.

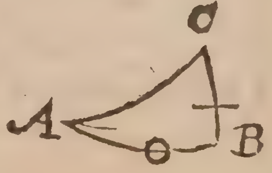
Of Right-angled Spherical Triangles.

Caſe I.

A Leg, and an Angle oppoſite thereto, being given, to find the other Leg; if it be known, whether the *Hypotenuſe*, or other Angle, be greater or leſs than a Quadrant.

Example.

In the Triangle ABC,
There is given,
BAC 23° 30′ }
BC 17 43 } AB required.



The Operation.

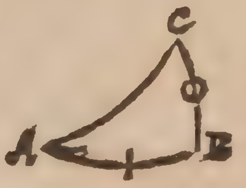
As Radius ———————— Log. 10.00000
To tc. BAC 23° 30′ ———————— 10.36170
So is t. BC 17 43 ———————— 9.50442
To S. AB required, 47° 17′ ———————— 19.86612

Caſe II.

A Leg and an adjacent Angle given, to find the other Leg.

Example.

In the Triangle ABC;
There is given,
BAC 23° 30′ }
A B 47 19 } BC required.



The

The Operation.

As tc. B A C 23° 30′ ———————— Log. 10.36170

To Radius ———————————— 10.00000
So is ſ. A B 47° 19′ ——————————— 9.86635

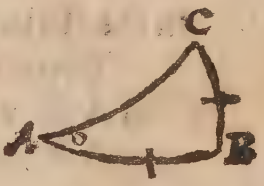
To t. B C required, 17° 43′ ——————————— 9.50465

Caſe III.

The Legs given, to find an Angle.

Example.

In the Triangle A B C,
There is given,
A B 47° 19′ } B A C required.
B C 17. 43 }



The Operation.

As t. B C, 17° 43′ ———————— Log. 9.50442

To Radius ———————————— 10.00000
So is ſ. A B 47° 19′ ——————————— 9.86635

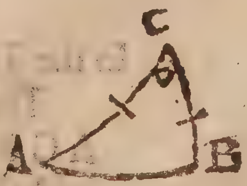
To tc. B A C required, 23° 30′ ——————— 10.36193

Caſe IV.

The *Hypotenuſe* and a Leg given, to find the contained Angle.

Example.

In the Triangle A B C,
There is given,
A C 49° 48′ } A C B required.
B C 17. 43 }



The Operation.

As Radius ——————————— Log. 10.00000

To t^{c}. A C 49° 48′ ——————————— 9.92689
So is t. B C 17° 43′ ——————————— 9.50442

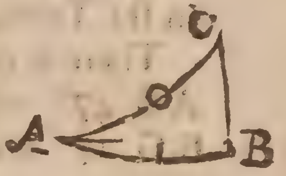
To ſc. A C B required, 74° 21′ ——————————— 19.43131

Caſe V.

A Leg and the adjacent Angle given, to find the *Hypotenuſe.*

Example.

In the Triangle A B C
There is given,
B A C 23° 30′ }
A B 47 19 } A C required.



The Operation.

As t. A B 47° 19′ ——————————— Log. 10.03516

To Radius ——————————— 10.00000
So is ſc. B A C 23° 30′ ——————————— 9.96240

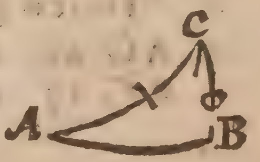
To tc. A C required, 49° 47′ ——————————— 9.92724

Caſe VI.

The *Hypotenuſe* and an Angle given, to find the Leg adjacent to the given Angle.

Example.

In the Triangle A B C
There is given,
A C B 74° 19′ }
A C 49 48 } B C required.



The Operation.

As tc. A C 49° 48′ ———————— Log. 9.92689

To Radius ———————— 10.00000
So is ſc. A C B 74° 19′ ———————— 9.43188

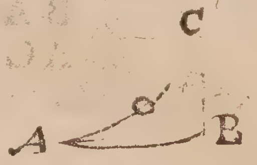
To t. B C required, 17° 44′ ———————— 9.50499

Caſe VII.

The Oblique Angles given, to find the *Hypotenuſe.*

Example.

In the Triangle A B C,
There is given,
A C B 74° 19′ } A C required.
B A C 23 30 }



The Operation.

As Radius ———————— Log. 10.00000

To tc. A C B, 74° 19′ ———————— 9.44836
So is tc. B A C 23 30 ———————— 10.36170

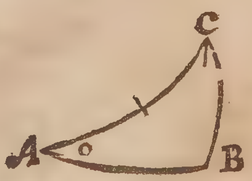
To ſc. A C required, 49° 47′ ———————— 19.81006

Caſe VIII.

The *Hypotenuſe* and one of the Angles given, to find the other Angle.

Example.

In the Triangle A B C,
There is given,
A C B 74° 19′ } B A C required.
AC 49 48 }



The Operation.

As tc. A C B 74° 19′ ——————————— Log. 9.44836

To Radius ——————————— 10.00000

So is ſc. A C 49° 48′ ——————————— 9.80987

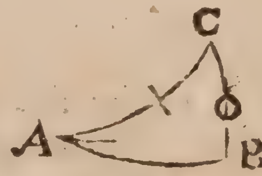
To tc. B A C required, 23° 31′ ——————————— 10.36151

Caſe IX.

The *Hypotenuſe* and an Angle given, to find the Leg oppoſite to the given Angle.

Example.

In the Triangle A B C
There is given,
B A C 23° 30′ } B C required.
A C 49 48 }



The Operation.

As Radius ——————————— Log. 10.00000

To ſ. B A C 23° 30′ ——————————— 9.60070

So is ſ. A C 49 48 ——————————— 9.88298

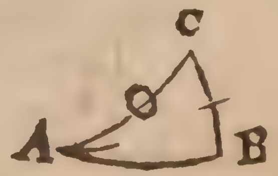
To ſ. B C required, 17° 43′ ——————————— ~~1~~9.48368

Caſe X.

A Leg, and an Angle oppoſite thereto, being given, to find the *Hypotenuſe*; If it be known, whether it or the other Leg, or unknown Angle, be greater or leſs than a Quadrant.

Example.

In the Triangle A B C,
There is given,
B A C 23° 30′ } A C required.
B C 17 43 }



The Operation.

As ſ. B A C 23° 30′ ——————————— Log. 9.60070

To Radius ——————————— 10.00000
So is ſ. B C 17° 43′ ——————————— 9.48332

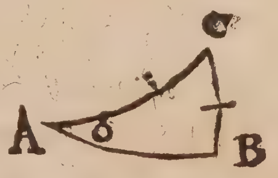
To ſ. A C required, 49° 45′ ——————————— 9.88262

Caſe XI.

The *Hypotenuſe* and a Leg given, to find the Angle oppoſite to the given Leg.

Example.

In the Triangle A B C,
There is given,
A C 49° 48′ }
B C 17 43 } B A C required.



The Operation.

As ſ. A C 49° 48′ ——————————— Log. 9.88298

To Radius ——————————— 10.00000
So is ſ. B C 17° 43′ ——————————— 9.48332

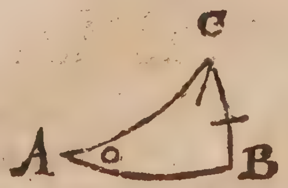
To ſ. B A C required, 23° 28′ ——————————— 9.60034

Caſe XII.

A Leg, and an Angle adjacent thereunto being given, to find the other Angle.

Example.

In the Triangle A B C,
There is given,
B C 17° 43′ }
A C B 74 19 } B A C required.



Th

The Operation.

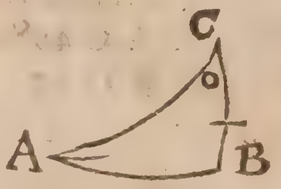
As Radius ———————————— Log. 10.00000
To ſ. A C B 74° 19′ —————————— 9.98352
So is ſc. B C 17 43 —————————— 9.97890
To ſc. B A C required, 23° 30′ ——————— 19.96242

Caſe XIII.

A Leg, and an Angle oppoſite thereto, being given, to find the other Angle; If it be known whether it, the other Leg, or the *Hypotenuſe*, be greater or leſs than a Quadrant.

Example.

In the Triangle A B C,
There is given,
B A C 23° 30′ }
B C 17 43 } A C B required.



The Operation.

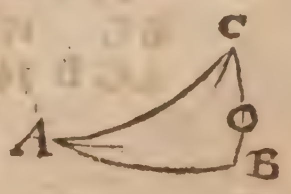
As ſc. B C 17° 43′ ———————————— Log. 9.97896
To Radius ———————————— 10.00000
So is ſc. B A C 23° 30′ —————————— 9.96240
To ſ. A C B required, 74° 19′ ——————— 9.98350

Caſe XIV.

The Oblique-Angles given, to find either Leg.

Example.

In the Triangle A B C,
There is given,
A C B 74° 19′ }
B A C 23 30 } B C required.



The Operation.

As ſ. A C B 74° 19′ ——————— Log. 9.98352

To Radius ——————— 10.00000

So is ſc. B A C 23° 30′ ——————— 9.96240

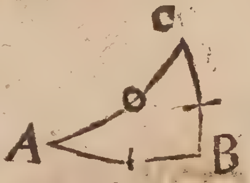
To ſc. BC required, 17° 43′ ——————— 9.97888

Caſe XV.

The Legs given, to find the *Hypotenuſe*.

Example.

In the Triangle A B C,
There is given,
A B 47° 19′ } A C required.
B C 17 43 }



The Operation.

As Radius ——————— Log. 10.00000

To ſc. A B 47° 19′ ——————— 9.83119

So is ſc. BC 17 43 ——————— 9.97890

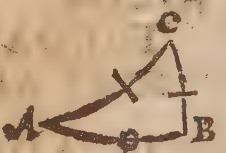
To ſc. A C required, 49°. 47′ ——————— 19.81009

Caſe XVI.

The Hypotenuſe and a Leg given, to find the other Leg.

Example.

In the Triangle A B C,
There is given,
A C 49°. 48′ } A B required.
B C 17 43 }



The Operation.

As ſc. BC 17° 43' ———— Log. 9.97890
To Radius ———— 10.00000
So is ſc. AC 49° 48' ———— 9.80987
To ſc. AB required, 47° 21' ———— 9.83097

SECT. III.

Of Oblique-angled Spherical Triangles.

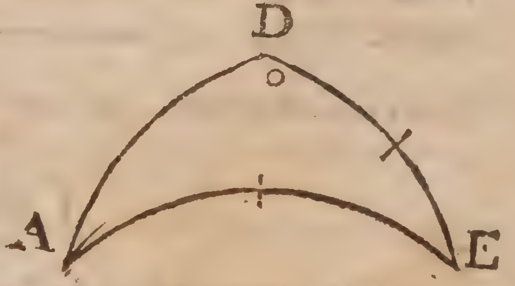
Caſe I.

TWo Sides, and an Angle oppoſite to one of them, being given, to find the other oppoſite Angle; if it be known, whether the Angle ſought be greater or leſs than a Right Angle.

Example.

In the Triangle ADE,
There is given

AE 69° 47'
DE 38 28
DAE 37 03
} ADE required, being Obtuſe.



The Operation.

As ſ. DE 38° 28' ———— Co. Ar. Log. 0.20617
To ſ. DAE 37 03 ———— 9.77996
So is ſ. AE 69 47 ———— 9.97238
To ſ. ADE required, 114° 39' ———— 19.95851

The

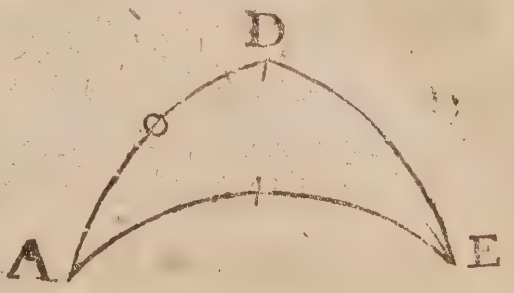
Caſe II.

Two Angles, and a Side oppoſite to one of them, being given, to find the other oppoſite Side; if it be known, whether it be greater or leſs than a Quadrant.

Example.

In the Triangle ADE,
There is given,

ADE 114° 38′ } AD required,
AED 45 00 } being leſs than
AE 69 47 } a Quadrant.



The Operation.

Co. Ar.
As ſ. ADE — 114° 38′ ———————— Log. 0.04144
To ſ. AE — 69 47 ———————— 9.97238
So is ſ. AED 45 00 ———————— 9.84948

To ſ. AD required, 46° 53′ ———————— ~~1~~9.86330

The Reſolution of this and the former Caſe depends upon the third *Axiom.*

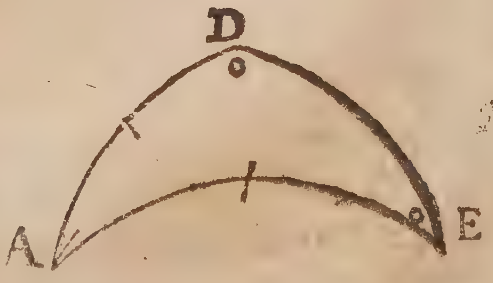
Caſe III.

Two Sides and their contained Angle being given, to find the other Angles.

Example.

In the Triangle ADE,
There is given,

DAE 37° 03′ } ADE }
AE 69 47 } & } required.
AD 46 53 } AED }



The Operation.

A E 69° 47′
A D 46 53

Sum, 116 40 $\frac{1}{2}$ Sum, 58° 20′

Diff. 22 54 $\frac{1}{2}$ Diff. 11 27
D A E 37 03 half thereof is 18° 31′

			Co. Ar.
As ſ. $\frac{1}{2}$ Z cr^{a}. A E and A D	58°	20′	Log. 0.07001
To ſ. $\frac{1}{2}$ X cr^{a}.	11	27	9.29779
So is tc. $\frac{1}{2}$ D A E	18	31	10.47506
To t. $\frac{1}{2}$ X VV D and E	34	51	19.84286

			Co. Ar.
As ſc. $\frac{1}{2}$ Z cr^{a}. A E and A D	58°	20′	Log. 0.27986
To ſc. $\frac{1}{2}$ X cr^{a}.	11	27	9.99127
So is tc. $\frac{1}{2}$ D A E	18	31	10.47506
To t. $\frac{1}{2}$ Z VV D and E	79	49	10.74619

$\frac{1}{2}$ Z VV D and E —— 79 49
$\frac{1}{2}$ X VV —— 34 51
Sum, 114 40 A D E } required.
Rem. 44 58 A E D }

Having by the fourth *Axiom* found the half Sum, and half Difference of the Angles; if to that half Sum you add the half Difference, the Total is the greater Angle; and if from the half Sum you ſubtract the half Difference, the Remainder is the leſſer Angle ſought.

Note.

If the Sum of the two containing Sides exceed a Semi-Circle, then ſubtract each Side ſeverally from 180, and proceed with thoſe Complements as with the Sides given in the Example aforegoing: The Operation produces the Complements of the Angles ſought to a Semi-Circle.

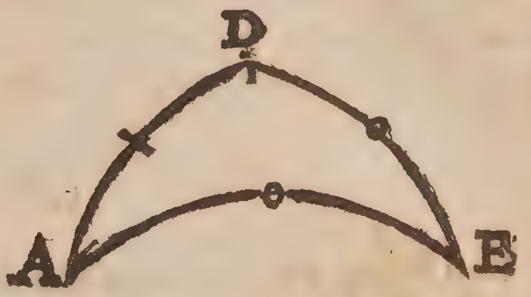
Caſe

Caſe IV.

Two Angles, and the interjacent Side being given, to find the other Sides.

Example.

In the Triangle A D E,
There is given,



$$\left.\begin{array}{lll}\text{DAE} & 26^{\circ} & 23' \\ \text{ADE} & 137 & 55 \\ \text{AD} & 81 & 50\end{array}\right\}\left\{\begin{array}{c}\text{AE} \\ \& \\ \text{DE}\end{array}\right\}\text{required.}$$

The Operation.

ADE	137°	55′		
DAE	26	23		
Sum,	164	18	$\frac{1}{2}$ Sum, ——	82° 09′
Diff.	111	32	$\frac{1}{2}$ Diff. ——	55 46
AD	81	50	half thereof,	40 55

Co. Ar.
As ſ. $\frac{1}{2}$ Z *VV* A and D 82° 09′ ———— Log. 0.00409
To ſ. $\frac{1}{2}$ X *VV* —— 55 46 ———— 9.91738
So is t. $\frac{1}{2}$ A D —— 40 55 ———— 9.93789

To t. $\frac{1}{2}$ X cr^{s}. AE & DE 35 52 ———— 19.85936

Co. Ar.
As ſc. $\frac{1}{2}$ Z *VV* A and D 82° 09′ ———— Log. 0.86461
To ſc. $\frac{1}{2}$ X *VV* —— 55 46 ———— 9.75017
So is t. $\frac{1}{2}$ A D —— 40 55 ———— 9.93789

To t. $\frac{1}{2}$ Z cr^{s} AE and DE 74 21 ———— 10.55267

$\frac{1}{2}$ Z cr^{s}. A E and D E 74 21
$\frac{1}{2}$ X cr^{s}. ———— 35 52

$$\begin{array}{lll}\text{Sum,} & 110\ \ 13 & \text{AE} \\ \text{Rem.} & 38\ \ 29 & \text{DE}\end{array}\Big\}\text{required.}$$

This Caſe is wrought by the fifth *Axiom*; and the half Sum of the Sides added to the half Difference, gives the greater Side; and the half Difference ſubtracted, leaves the leſs.

Note.

If the Sum of the given Angles exceed 180°, ſubtract each Angle from 180°, and proceed with the Reſidues, the Operation will produce each Sides Compl. to a Semi-Circle.

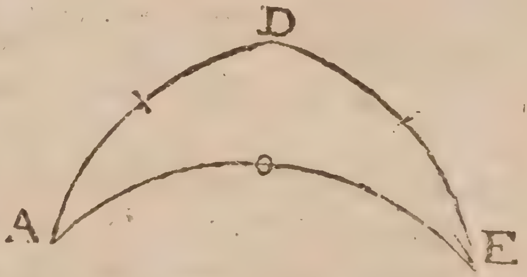
Caſe V.

Two Sides, and an Angle oppoſite to one of them, being given, to find the third Side; if it be known whether the other oppoſite Angle, or the required Side, be greater or leſs than a Quadrant.

Example.

In the Triangle A D E,
There is given,

AD 46° 53′ } And A E required,
DE 38 28 } being leſs than a
AED 45 00 } Quadrant.



The Operation of this Caſe depends upon the third and fifth *Axioms.*

Firſt, By the third *Axiom* find the Angle oppoſite to the other given Side.

Secondly, Having two Sides, and their oppoſite Angles, you may find the third Side by the former part of the fifth *Axiom* inverted.

The Operation.

As ſ. A D —	46° 53′	Co. Ar.
To ſ. A E D	45 00	Log. 0.13670
So is ſ. D E	38 28	9.84948
		9.79383
To ſ. D A E	37 03	19.78001

AED 45° 00′
DAE 37 03

Sum, 82 03 ½ Sum, 41° 01′

Diff. 07 57 ½ Diff. 03 58

AD 46 53
DE 38 28

Diff. 08 25 ½ Diff. 04 12

			Co. Ar.
As ſ. ½ X VV A and E	03°	58′	Log. 1.16004
To ſ. ½ Z VV	41	01	9.81709
So is t. ½ X cr^{2}.AD & DE	04	12	8.86590
To t. ½ A E required,	34	52	~~1~~9.84303

34 52
34 52

A E, 69 44 required.

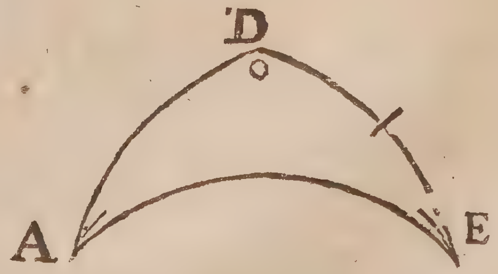
Caſe VI.

Two Angles and a Side oppoſite to one of them, being given, to find the third Angle; if it be known, whether the oppoſite Side, or Angle required, be greater or leſs than a Quadrant.

Example.

In the Triangle A D E,
There is given,

DAE 37° 03′
AED 45 00
ED 38 28
} A D E required, being Obtuſe.



The Reſolution of this Caſe depends upon the third and fourth *Axioms.*

Firſt, By the third *Axiom* find the Side oppoſite to the other Angle. *Secondly*, Having the two Angles, and their oppoſite Sides, the third Angle may be found by the former part of the fourth *Axiom* inverted.

The Operation.

As ſ. D A E——37° 03′ ———————— Co. Ar: Log. 0.22004
To ſ. D E——38 28 ———————— 9.79383
So is ſ. A E D 45 00 ———————— 9.84948
To ſ. A D—— 46 53 ———————— 19.86335

A D 46 53
D E 38 28
Sum, 85 21 $\frac{1}{2}$ Sum, 42° 40′
Diff. 08 25 $\frac{1}{2}$ Diff. 04 12

A E D 45 00
D A E 37 03
Diff. 07 57 $\frac{1}{2}$ Diff. 03 58

As ſ. $\frac{1}{2}$ X cr^a. A D and D E 04° 12′ ———— Co. Ar. Log. 1.13527
To ſ. $\frac{1}{2}$ Z cr^a. ———— 42 40 ———— 9.83106
So is t. $\frac{1}{2}$ X *VV* A and E 03 58 ———— 8.84100
To tc. $\frac{1}{2}$ A D E required, 57 19 ———— 19.80733
57 19
A D E 114 38 required.

Caſe VII.

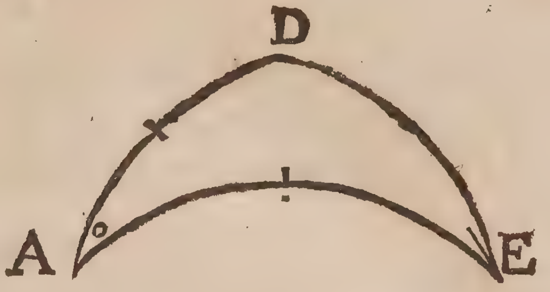
Two Sides, and an Angle oppoſite to one of them, being given, to find the contained Angle; if it be known, whether the other oppoſite Angle, or the Angle required be Acute or Obtuſe.

Example.

Example.

In the Triangle A D E
There is given,

A E D 45° 00′ } D A E required,
A E 110 13 } being Acute.
A D 81 50 }



This Caſe is wrought by the help of the third and fourth *Axioms.*
Firſt, By the third *Axiom*, to find the other oppoſite Angle.
Secondly, By the fourth *Axiom*, to find the contained Angle.

The Operation.

Co. Ar.
As ſ. A D 81° 50′ —————— Log. 0.00443
To ſ. A E D 45 00 —————— 9.84948
So is ſ. A E 110 13 —————— 9.97238

To ſ. A D E 137 55 required, —————— 19.82629

A D E 137 55
A E D 45 00
Diff. 92 55 $\frac{1}{2}$ Diff. 46° 27′

A E 110 13
A D 81 50
Sum, 192 03 $\frac{1}{2}$ Sum, 96 01
Diff. 28 23 $\frac{1}{2}$ Diff. 14 11

Co. Ar.
As ſ. $\frac{1}{2}$ X cr^{s}. A E and A D 14° 11′ —————— Log. 0.61079
To ſ. $\frac{1}{2}$ Z cr^{s}. —————— 96 01 —————— 9.99760
So is t. $\frac{1}{2}$ X *VV* D and E 46 27 —————— 10.02199

To tc. $\frac{1}{2}$ D A E required, 13 11 —————— 10.63038
13 11
D A E 26 22 required.

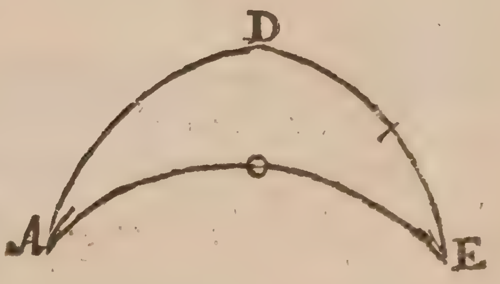
Caſe VIII.

Two Angles, and a Side oppoſite to one of them, being given, to find the interjacent Side; if it be known, whether the other oppoſite Side, or Side ſought, be greater or leſſer than a Quadrant.

Example.

In the Triangle A D E,
There is given,

A E D	45° 00′	A E required,
D A E	37 03	being leſs than
D E	38 28	a Quadrant.



This Caſe is reſolved by the third and fifth *Axioms.*

Firſt, By the third *Axiom*, to find the other oppoſite Side.

Secondly, By the fifth *Axiom*, to find the interjacent Side.

The Operation.

		Co. Ar.
As ſ. D A E	37° 03′	Log. 0.22004
To ſ. D E	38 28	9.79383
So is ſ. A E D	45 00	9.84948
To ſ. A D	46 53	19.86335

A E D	45 00	
D A E	37 03	
Sum,	82 03	½ Sum, 41° 01′
Diff.	07 57	½ Diff. 03 58

AD	46 53	
DE	38 28	
Diff.	08 25	½ Diff. 04 12

As

Co. Ar.
As ſ. ½ X VV A and E —— 03° 58′ ——————— Log. 1.16005
To ſ. ½ Z VV ——— 41 01 ———————— 9.81709
So is t. ½ X cr^{2}. AD and DE 04 12 ——————— 8.86590

To t. ½ A E required, —34 52 ———————— 19.84304

34 52
34 52

A E 69 44 required.

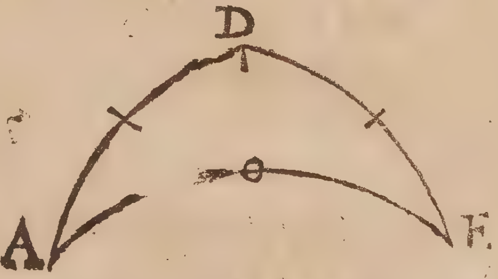
Caſe IX.

Two Sides, and their contained Angle being given, to find the third Side.

Example.

In the Triangle A D E,
There is given,

A D E 137° 55′ }
A D 81 50 } A E required.
D E 38 28 }



The Reſolution of this and the following Caſe is deduced from the Lord *Napier's Catholick Propoſition* (the Oblique Triangle by a ſuppoſed Perpendicular being reduced into two Rectangulars) by the ingenious Mr. *Collins*, in his *Sector on a Quadrant*, whom in this I ſhall imitate.

The Operation.

As Radius ———————————— Log. 10.00000

To ſc. A D E the contained Angle, 137° 55′ ——— 9.87050
So is t. D E the leſſer Side, ——— 38 28 ——— 9.90009

To t. of a fourth Arch, ——— 30 31 ——— 19.77056

If the contained Angle be leſs than 90°, ſubtract the fourth Arch from the greater Side; but if it be greater than 90°, from its Complement to 180°, the Remainder is the Reſidual Arch.

Co: Ar.
As ſc. of the fourth Arch, 30° 31′ ——— Log. 0.06476
To ſc. of the Reſidual, 67 39 ——— 9.58008
So is ſc. of the leſſer Side DE 38 28 ——— 9.89374

To ſc. of the Side required, A E 110° 13′ ——— 19.53858

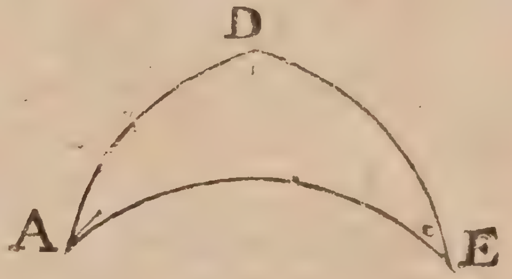
Caſe X.

Two Angles, and the interjacent Side being given, to find the third Angle.

Example.

In the Triangle A DE,
There is given

A D E 114° 39′
D A E 37 03 } A E D required.
A D 46 53



The Operation.

As Radius ——— Log. 10.00000

To ſc. A D the interjacent Side, 46° 53′ ——— 9.83473
So is t. D A E the leſſer Angle, 37 03 ——— 9.87790

To t. of the fourth Arch, ——— 27 17 ——— 19.71263

If the interjacent Side be more than a Quadrant, ſubtract the fourth Arch from the greater Angle; if leſs, from the ſaid Angle's Complement to 180°, the Remainder is the Reſidual Arch.

Co. Ar.
As ſc. 4*th* Arch ——— 27° 17′ ——— Log. 0.05122
To ſc. Reſidual Arch ——— 38 04 ——— 9.89614
So is ſc. D A E the leſſer Angle 37 03 ——— 9.90206

To ſc. A E D the Angle required, 45 00 ——— 19.84942

In this and the foregoing Caſe, the Affection of the required Side or Angle may be determined by the Reſidual Arch.

For if the contained Angle, or interjacent Side be leſs than a Quadrant, and the Reſidual Arch more; or when the contained Angle, or interjacent Side is greater than a Quadrant, and the Reſidual Arch leſs, the Side or Angle required is greater than 90°, in all other Caſes leſs.

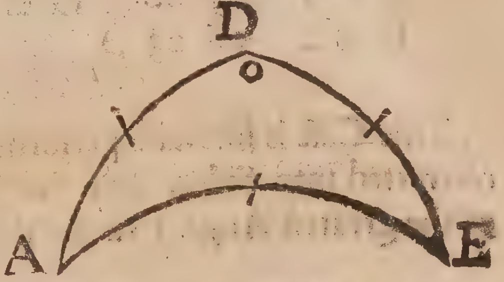
Caſe XI.

Three Sides given, to find an Angle.

Example.

In the Triangle A D E,
There is given,

A E 110° 13′ }
A D 81 50 } A D E required.
D E 38 28 }



The Reſolution of this Caſe depends upon the ſixth *Axiom*; and for the more ſpeedy Operation take this brief Direction.

Add the three Sides together, and from their half Sum ſubtract the Side oppoſite to the Angle required.

Then to the Complements Arithmetical of the Logarithm-Sines of the containing Sides, add the Logarithm-Sines of the half Sum and Remainder; Half the total of theſe four Logarithms is the Sine Complement of half the Angle required.

The Operation.

A D	81°	50′	The containing Sides.	S.	Co. Ar. 0.00443
D E	38	28		S.	Co. Ar. 0.20617
A E	110	13	½ Sum, 115° 15′	S.	9.95639
Sum,	230	31	Rem. 05 02	S.	8.94317
½ Sum,	115	15			Sum, 19.11016
Remain.	05	02	ſc. 68° 57′		½ Sum, 9.55508

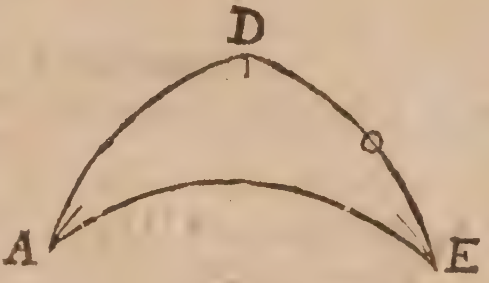
Which being doubled, produces A D E 137°. 54′ required.

Caſe XII.

Three Angles given, to find a Side.

Example.

In the Triangle A D E,
There is given,



A D E	137° 55′	D E required.
A E D	45 00	
D A E	26 23	

This Caſe is likewiſe performed by the ſixth *Axiom*, the Angles being converted into Sides, and the Sides into Angles, by taking the Comp. of the greateſt Angle to a Semi Circle.

Compl. A D E	42° 05′	The adjacent Angles,	S.	Co. Ar. 0.17379
A E D	45 00		S.	Co. Ar. 0.15052
D A E	26 23	½ Sum, 56° 44′	S.	9.92227
Sum,	113 28	Rem. 30 21	S.	9.70353
½ Sum,	56 44			Sum, 19.95011
Rem.	30 21	ſc. 19 15		½ Sum, 9.97505

Which, being doubled, gives D E 38° 30′ required.

If the greater Side A E were required, the Operation would produce the Complement thereof to a Semi-Circle; which ſubtracted from 180°, it leaves the Side ſought.

CHAP.

CHAP. V.

The Doctrine of Plain Triangles applied in PROBLEMS *of* **Plain Sailing.**

SECT. I.

The Application of Right-angled Triangles in Plain-Sailing.

ALthough the Ground and Projection of the Plain Chart be erroneous, yet ſeeing it is more facile to the Learner, and may ſerve as an Introduction to what is more difficult, it ſhall not be here omitted.

Problem I.

The Courſe and Diſtance given, to find the Difference of Latitude and the Departure.

Example.

A Ship ſailing N. E. by N. 372 Minutes:
I demand her Difference of Latitude and Departure.

Plate 1. *Fig*. 1.

In the Triangle A B C,

A C repreſents the Diſtance ſailed.
A B the Diff. Latitude.
B G the Departure.
B A C the Angle of the Courſe from the Meridian.
A C B the Compl. of the Courſe.

The Operation.

For the Diff. Latitude.

As Radius ——————————— Log. 10.00000

To the Diſtance ſailed, ——— 372′ ——————— 2.57054

So is ſc. of the Courſe, ——— 33° 45′ ——————— 9.91985

To the Diff. Latitude, ——— 309 ——————— ~~1~~2.49039

For the Departure.

As Radius ——————————— Log. 10.00000

To the Diſtance ſailed, ——— 372′ ——————— 2.57054

So is S. Courſe, ——— 33° 45 ——————— 9 74474

To the Departure, ——— 206 ——————— ~~1~~2.31528

Problem II.

The Courſe and Diff. Latitude being given, to find the Diſtance and Departure.

Example.

A Ship ſailing N. W. by N. until her Difference of Latitude be 309′, I demand her Diſtance and Departure.

Plate I. *Fig.* 2.

The Operation.

For the Diſtance.

As ſc. of the Courſe ——— 33° 45′ ——— Log. 9.91985

To the Diff. Latitude ——— 309 ——————— 2.48996

So is Radius ——————————— 10.00000

To the Diſtance ſailed, ——— 371 ——————— 2.57011

For the Departure.

		Co. Ar.
As ſc. Courſe	33° 45′	Log. 0.08015
To the Diff. Lat.	309	2.48996
So is ſ. Courſe	33 45	9.74474
To the Departure	206	12.31485

Problem III.

The Courſe and Departure given, to find the Diſtance and Difference of Latitude.

Example.

A Ship ſailing S. E. by S. until her Departure be 206′, I demand the Diſtance and Difference of Latitude.

Plate 1. *Fig.* 3.

The Operation.

For the Diſtance.

As ſ. Courſe	33° 45′	Log. 9.74474
To the Departure	206	2.31387
So is Radius		10.00000
To the Diſtance	370	2.56913

For the Diff. Latitude.

		Co. Ar.
As ſ. Courſe	33° 45′	Log. 0.25526
To the Departure	206	2.31387
So is ſc. Courſe	33 45	9.91985
To Diff. Lat.	308	12.46898

Problem IV.

The Diſtance and Difference of Latitude given, to find the Courſe and Departure.

Example.

Example.

A Ship ſails between the North and the Eaſt 372′, until her Difference of Latitude be 309′; I demand the Courſe and Departure.

Plate 1. *Fig.* 4.

The Operation.

For the Courſe.

As the Diſtance ſailed, 372′ ——————— Log. 2.57054
To Radius ——————————— 10.00000
So is the Diff. Lat. 309 ——————— 2.48996
To the ſc. Courſe 33° 50′ ——————— 9.91942

For the Departure.

As Radius ——————————— Log. 10.00000
To the Diſtance, —372′——————— 2.57054
So is the ſ. Courſe, 33° 50 ——————— 9.74568
To the Departure —207 ——————— 12.31622

Problem V.

The Diſtance and Departure given, to find the Courſe and Difference of Latitude.

Example.

A Ship ſails between the South and the Weſt 372′, until her Departure be 206′; I demand the Courſe and Diff. of Latitude.

Plate 1. *Fig.* 5.

The Operation.

For the Courſe.

As the Diſtance — 372′ ——————— Log. 2.57054
To Radius ——————————— 10.00000
So is the Departure 206 ——————— 2.31387
To the ſ. Courſe 33° 37 ——————— 9.74333

For the Diff. Latitude.

As Radius ———————— Log. 10.00000
To the Diſtance —— 372′ ———— 2.57054
So is ſc. of the Courſe, 33° 37 ———— 9.92052
To the Diff. Latitude, 309 ———— ~~1~~2.49106

Problem VI.

The Difference of Latitude, and Departure given, to find the Courſe and Diſtance.

Example.

A Ship ſailing between the South and Weſt, until her Diff. Latitude be 309 min. and her Departure 206 min. I demand the Courſe and Diſtance.

Plate 1. *Fig.* 6.

The Operation.

For the Courſe.

As the Diff. Lat. 309 min. ———— Log. 2.48996
To Radius ———————— 10.00000
So is the Departure, 206 min. ———— 2.31387
To t. Courſe 33° 41′ ———— 9.82391

For the Diſtance.

As ſ. Courſe —— 33° 41′ ———— Log. 9.74398
To the Departure 206 ———— 2.31387
So is Radius ———————— 10.00000
To the Diſtance —— 371 ———— 2.56989

SECT. II.

The Doctrine of Oblique Triangles applied in Problems of Plain Sailing.

Problem I.

TWo Ships ſail from the ſame Port, the one ſails E. N. E. 40 min. the other E. by S. ſo far, until ſhe find the firſt Ship bear N. W. by W. I demand the ſecond Sihp's Diſtance from the Port, and the Diſtance between the two Ships.

In the Triangle A D E. *Plate* 1. *Fig.* 7.
A repreſents the Port.
A D the E. N. E. Courſe, and A E the E. by S. Courſe.

The Operation.

To find the ſecond Ship's Diſtance from the Port.

As S. A E D	22° 30′	Co. Ar. Log. 0.41716
To A D	40	1.60206
So is S. A D E	123 45	9.91985
To A E	86	11.93907

To find the Diſtance between the Ships.

As S. A E D	22° 30′	Co. Ar. Log. 0.41716
To A D	40	1.60206
So is S. D A E	33 45	9.74474
To D E	58	11.76396

Problem II.

Suppoſe there are two Ports that lie Eaſt and Weſt one from another, one Ship ſails from the Weſtermoſt Port N. E. 41′, the other ſails from the Eaſtermoſt Port 80′, and meets with the firſt Ship: I demand the Courſe ſteer'd by the ſecond Ship, and the Diſtance betwixt the two Ports.

Plate 1. *Fig.* 8.

Let A repreſent the Weſtermoſt Port,
E the Eaſtermoſt,
A D the Courſe and Diſtance of the firſt Ship,
D the Place where the Ships meet.

To find the ſecond Ship's Courſe.

The Operation.

		Co. Ar.
As D E	80′	Log. 8.09691
To ſ. D A E	45° 00	9.84948
So is A D	14	1.61278
To ſ. A E D	21 14	~~1~~9.55917

The Courſe is N. W. 68° 46′, or W. N. W. a little Weſterly.

To find the Diſtance between the two Ships.

		Co. Ar.
As ſ. D A E	45° 00′	Log. 0.15052
To E D	80	1.90309
So is ſ. ADE	113 46	9.96151
To A E	103	~~1~~2.01512

Problem III.

Suppoſe two Ships ſet ſail from a certain Road, the one ſails S. by E. 20 min. the other S. S. W. 25 m. I demand their Bearing and Diſtance from each other.

Plate 1. *Fig.* 9.

In the Triangle A D E,
A repreſents the Road,
A D the firſt Ship's Courſe and Diſtance,
A E the ſecond Ship's Courſe and Diſtance.

The Operation.

To find the Bearings.

A E	25		180° 00′
A D	20	D A E	33 45
Sum,	45	Sum,	146 15, ZVV A D E and A E D.
Diff.	05	½ Sum,	73 07

		Co. Ar.
As Z cr^s. A E and A D	45	Log. 8.34679
To their Differ.	05	0.69897
So is t. ½ ZVV D and E	73° 07′	10.51783
To t. ½ their Differ.	20 06	x9,56359

½ Z VV	73° 07′	
½ X VV	20 06	
Sum,	93 13	A D E
Diff.	53 01	A E D

The Bearings of the Ships are N. E. 75° 31′, and S. W. 75° 31′: or E. N. E. ¾ E. and W. S. W. ¾ W. *ferè*.

To find their Diſtance.

		Co. Ar.
As S. A E D	53° 01′	Log. 0.09756
To A D	20	1.30103
So is ſ. D A E	33 45	9.74474
To D E	13	x1.14333

Problem IV.

A Ship ſails from a certain Port S. S. E. 68 min. and then ſails 72 min. more Eaſterly; but is forced back by foul Weather 82 min. to the Port from whence ſhe ſet ſail: I demand what Courſe ſhe ſteered from the ſecond Place to the third, and how ſhe ſailed back to the firſt Port.

Plate 1. *Fig.* 10.

Let A repreſent the Port,
E the ſecond Place,
D the third Place.

The Operation.

To find the Courſe from the ſecond Place to the third.

A D	82
A E	68
Sum,	150
Diff.	14

		Co. Ar.
As D E the Baſe	72′	Log. 8.14267
To Z cr^{s}. A E and A D	150	2.17609
So is their Difference	14	1.14613
To a Segment of the Baſe,	29	~~1~~1.46489

D E	72′	D E	72
Segment	29	Segment	29
Diff.	43	Sum	101

$\frac{1}{2}$ Diff. 21 $\frac{1}{2}$ or 21′ $\frac{5}{10}$ E B. $\frac{1}{2}$ Sum 50 $\frac{1}{2}$ D B 50 $\frac{5}{10}$.

As A E	68′	Log. 1.83251
To Radius		10.00000
So is E B	21′ $\frac{5}{10}$	1.33244
To ſc. A E B or A E D,	71° 34′	9.49993

The Courſe from the ſecond Place to the third, is N. E. 49° 04′, or N. E. $\frac{1}{2}$ E. *ferè.*

To find the Courſe back to the Port.

	Co. Ar.
	Log. 8.08619
As A D 82 min.	9.97712
To ſ. A E D, 71° 34′	1.83251
So is A E 68 min.	
To ſ. A D E 51° 53′	~~1~~9.89582

The Courſe to the Port is N. W. 79° 03′, or W. by N. a little Weſterly.

CHAP.

CHAP. VI.

The Doctrine of Plain Right-angled Triangles applied in PROBLEMS *of* Mercator's Sailing.

THE true Sea-Chart, commonly called *Mercator*'s-*Chart*, (which is the uſeful Invention of our Country-Man Mr. *Edward Wright*, although this Stranger hath got the Name thereof) performs the like Concluſions, and almoſt in the ſame manner for eaſe, and yet moſt exactly; becauſe all Places may be laid down upon this Chart with the ſame Truth as upon the Globe, both as to their Latitude and Longitude, Bearing and Diſtance from each other.

Problem I.

To find the Meridional Difference of Latitude, or the Difference of Latitude in Meridional Parts.

Firſt, If one Place be under the Equinoctial, and the other in North or South Latitude, the Meridional Parts (in the Table of Meridional Parts) anſwering to the Degrees and Minutes of the Place's Latitude, is the Meridional Diff. of Latitude.

Example.

One Place in the Latitude 37° 27′ North, the other under the Equinoctial: I demand the Difference of Latitude in Meridional Parts.

Lat. 37° 27′——————————————2426
2426 is the Meridional Diff. Latitude.

Secondly, If two Places be both in North, or both in South Latitude, ſubtract the Meridional Parts of the leſs Latitude from thoſe of the greater, the Remainder is the Meridional Diff. Latitude.

Example 1.

	M.Pts.
One Place in the Latitude 37° 20′ N.	2418
The other in the Latitude 17 10 N.	1046
The Meridional Diff. Latitude,	1372

Example 2.

	M.Pts.
One Place in the Latitude 45° 56′ S.	3110
The other in the Latitude 29 17 S.	1839
The Meridional Diff. Latitude,	1271

Thirdly, If of the two Places the one have North Latitude, the other South, add the Meridional Parts of each Latitude together, the Sum is the Diff. Latitude in Meridional Parts.

Example.	M.Pts.
One Place in the Latitude 42° 17′ S.	2805
The other in the Latitude 27 19 N.	1705
The Meridional Diff. Latitude.	4510

Problem II.

Both Latitudes, and the Difference of Longitude between any two Places being given, to find the Courſe and Diſtance.

Example.

Example.

Admit the *Lizard* in the Latitude 50° North, and the *Barbadoes* in the Latitude 13° 12′ North, the Difference of Longitude 52° 57′ Weſt; I demand the Courſe and Diſtance.

In the Right-angled Triangle A b c,
  A b repreſents the proper Difference of Latitude,
  b c the Departure,
  Ac the Diſtance ſailed,
  b A c the Courſe,
  A c b the Compl. of the Courſe.

Plate 1. *Fig.* 11.

In the Right-angled Triangle A B C,
  A B repreſents the Meridional Diff. Latitude,
  BC the Difference of Longitude,
  B A C the Angle of the Courſe,
  A C B the Compl. of the Courſe.

The Difference of Longitude reduced to minutes, makes 3177 min.

To find the Meridional Difference of Latitude.

		M.Pts.
One Place in the Latitude	50° 00′ N.	3475
The other in the Latitude	13 12 N.	799
The Meridional Diff. Latitude,		2676

The Operation.

For the Courſe.

As Merid. Diff. Lat. 2676 min.————————	Log. 3.42749
To Radius ————————————	10.00000
So is the Diff. Longitude 3177 min.————————	3.50202
To t. Courſe 49° 53′ ————————	10.07453

The Courſe is S. W. ½ W.

Lat.

For the Diſtance.

Lat. 50° 00′
Lat. 13 12

Proper Diff. Lat. 36 48, which is 2208 min.

As ſc. Courſe —— 49° 53′ —————— Log. 9.80912

To proper Diff. Lat. 2208 ———————— 3.34400
So is Radius ——————————————— 10.00000

To the Diſtance —— 3426 ———————— 3.53488

Problem III.

Both Latitudes and the Courſe given, to find the Diſtance and Difference of Longitude.

Example.

A Ship ſails from the Lat. 50 North, until ſhe be in the Latitude of 13° 12′ North, her Courſe S. W. 50° 57′, or S. W. ½ W. ſomewhat more Weſterly; I demand the Diſtance, and Difference of Longitude.

The proper Difference of Latitude is 2208 min.
The Meridional Difference of Latitude is 2676 min.

The Operation,

For the Diſtance.

As ſc. Courſe ———— 50° 57′ ——— Log. 9.79934

To the Difference of Latitude 2208 ———— 3.34400
So is Radius ——————————— 10.00000

To the Diſtance ——— 3504 ———— 3.54466

For the Difference of Longitude.

As Radius ———————————— Log. 10.00000

To the Merid. Diff. Lat. —— 2676′ ———— 3.42749
So is t. Courſe, ——— 50° 57 ———— 10.09086

To the Difference of Longit. 3298 ———— 13.51835

Problem IV.

Both Latitudes and the Diſtance given, to find the Courſe and Difference of Longitude.

Example.

A Ship ſails from the Lat. 50° North, 3505′, until ſhe be in the Latitude 13° 12′ North; I demand the Courſe and Difference of Longitude.

The Meridional Difference of Latitude is 2676 min.
The proper Difference of Latitude is 2208 min.

The Operation.

For the Courſe.

As the Diſtance ——— 3505′ ——— Log. 3·54469
To Radius ——— 10·00000
So is the Difference of Lat. 2208 ——— 3·34400
To ſc. Courſe ——— 50° 57 ——— 9·79931

For the Difference of Longitude.

As Radius ——— Log. 10·00000
To the Merid. Diff. Lat. — 2676′ ——— 3·42749
So is t. Courſe, ——— 50° 57 ——— 10·09086
To the Difference of Longit. 3298 ——— 3·51835

Problem V.

One Latitude, the Courſe and Difference of Longitude being given, to find the other Latitude, and the Diſtance.

Example.

A Ship ſails S. W. 50° 57′, or S. W. ½ W. ſomewhat more Weſterly, from the Latitude 50° North, until the Difference of Longitude be 3297′; I demand the other Latitude and Diſtance.

The

The Operation.

For the other Latitude.

As t. Courſe ——— 50° 57′ ——— Log. 10.09086

To the Difference of Longit. 3297 ——— 3.51812
So is Radius ——— 10.00000

To the Merid. Diff. Lat. 2674 ——— 3.42726

M.Pts.
The Meridional Parts anſwering to Latit. 50° North, are 3475
From which ſubtract 2674

There remains 801

Againſt which, in the Table of Meridional Parts, is the Latitude of 13° 14′, which is the Latitude of the Place, North.

For the Diſtance.

The proper Difference of Latitude is 2206 min.

As ſc. Courſe ——— 50° 57′ ——— Log. 9.79934

To the Difference of Latitude 2206 ——— 3.34360
So is Radius ——— 10.00000

To the Diſtance ——— 3501 ——— 3.54426

Problem VI.

One Latitude, the Courſe and Diſtance given, to find the other Latitude and Difference of Longitude.

Example.

A Ship being in the Latitude 50° North, ſails S. W. 50° 57′, or S. W. ½ W. and ſomewhat more Weſterly 3505′; I demand the other Latitude, and Difference of Longitude.

The Operation.

For the Diff. Latitude.

As Radius ——————————— Log. 10.00000

To the Diſtance, ——— 3505′ ——————— 3.54469
So is ſc. Courſe, ——— 50° 57 ——————— 9.79934

To the Diff. Latitude, 2208 ——————— 3.34403
The other Latitude is 13 deg. 12 min. North.
The Meridional Diff. Latitude is 2676 min.

For the Difference of Longitude.

As Radius ——————————— Log. 10.00000

To the Meridional Diff. Lat. 2676′ ——————— 3.42749
So is t. Courſe ——— 50° 57 ——————— 10.09086

To the Diff. of Longitude 3298 ——————— 13.51835

Problem VII.

Two Places both in one Parallel or Latitude, and their Difference of Longitude being given, to find the Diſtance between them.

Example.

Suppoſe two Places both in the Parallel or Latitude of 50 deg. and their Difference of Longitude 70 deg. I demand the Diſtance between them.

The Operation.

The Difference of Longitude in Minutes, is 4200.

As Radius ——————————— Log. 10.00000

To Diff. Longitude 4200 min. ——————— 3.62325
So is ſc. Latitude 50 deg. ——————— 9.80807

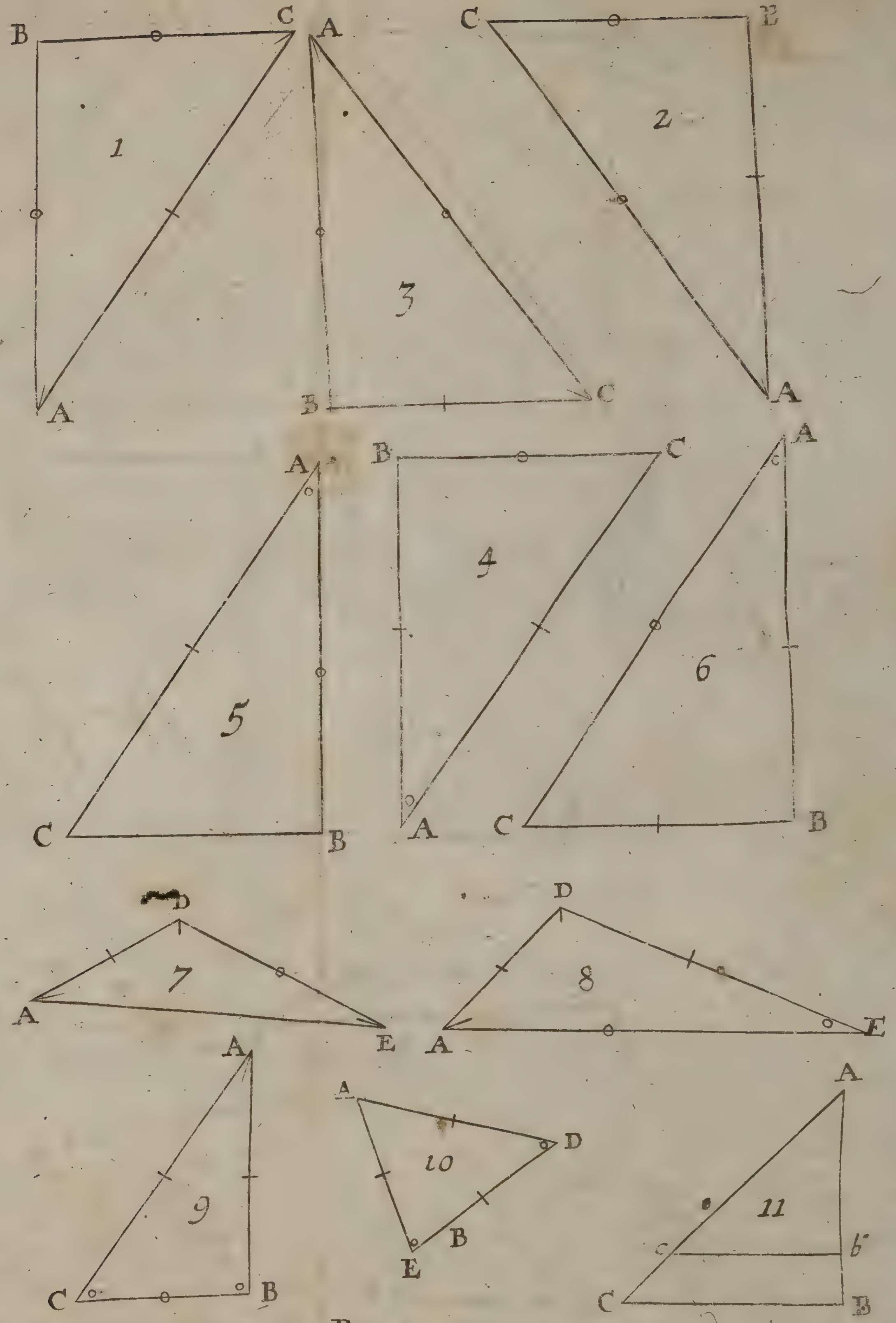
To the Diſtance 2700 min. ——————— 3.43132

Problem VIII.

Two Places both in one Latitude, and their Diſtance given, to find their Difference of Longitude.

Example.

Plate I



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Example.

Suppoſe two Places both in the Latitude 50 deg. and the Diſtance between 2700 min.

I demand the Difference of Longitude.

The Operation.

As ſc. Latitude 50 deg. ——————— Log. 9.80807

To the Diſtance 2700 min. ——————— 3.43136

So is Radius ——————— 10.00000

To the Diff. Long. 4200 min. ——————— 3.62329

Problem IX.

Two Places ſituate both in one Parallel or Latitude, their Diſtance and Difference of Longitude being given, to find the Parallel of Latitude.

Example.

A Ship ſailing due Weſt, 2700 min. until
her Diff. Longitude be 4200 min.
I demand what Latitude the Ship ſails in.

The Operation.

As Diff. Longitude 4200 min. ——————— Log. 3.62325

To Radius ——————— 10.00000

So is the Diſtance 2700 min. ——————— 3.43136

To ſc. Latitude 50 deg. ——————— 9.80811

CHAP. VII.

The Doctrine of Spherical Triangles applied in PROBLEMS *of* Great Circle Sailing.

ALthough it be hardly poſſible for a Ship exactly to trace out the Arch of a Great Circle, yet it may be of Advantage to keep conveniently near it, eſpecially in a Parallel (or Eaſt and Weſt) Courſe.

Problem I.

Two Places differing only in Longitude.

Example.

A Ship being in the Latitude 50° North, is bound to a Port in the ſame Parallel, whoſe Difference of Longitude Weſterly is 47°; I demand the Angles of Poſition, the Diſtance in the Arch of a Great Circle, by what Latitudes and Longitudes the Arch ſhall paſs, likewiſe the Courſe and Diſtance from Place to Place, according to *Mercator*.

Let A repreſent the firſt Place.
E the ſecond.

Plate 1. Fig. 12.

The Operation.

To find the Angles of Poſition, B A D and B E D.

The Oblique-angled Triangle A D E is reduced into two equal Right-angled Triangles A B D and E B D, the Sides and Angles being equal; therefore in either of them there is given the *Hypotenuſe*, and the Angle at D, to find the Angle at A or E.

In the Triangle A B D:

As tc. A D B 23° 30′ ——————— Log. 10.36170
To Radius ——————————— 10.00000
So is ſc. A D 40 00 ——————————— 9.88425
To tc. B A D 71 35 ——————————— 9.52255

2. To find the Diſtance A E.

In the Triangle A B D.

As Radius ——————————— Log. 10.00000
To ſ. D A — 40° 00′ ——————————— 9.80807
So is ſ. A D B 23 30 ——————————— 9.60070
To ſ. A B — 14 51 ——————————— 9.40877
A B — 14 51 being doubled, produces
A E — 29 42, or 1782 min.

3. To find the Latitudes by which the Arch ſhall paſs at every five Degrees of Longitude from A, repreſenting the firſt Port.

Firſt, You muſt find the greateſt Latitude by which the Arch paſſes, D B.

In the Triangle A B D.

As tc. A D — 40° 00′ ——————————— Log. 10.07619
To Radius ——————————— 10.00000
So is ſc. A D B 23 30 ——————————— 9.96240
To t. B D — 37 35 ——————————— 9.88621

The Compl. of B D (to 90°) 52° 25′ is the greateſt Latitude.

Secondly, To find the Latitude by which the Arch paſſes at every five Degrees of Longitude from A, you muſt reſolve the ſeveral Right-angled Triangles, B D a, B D c, B D e, *&c.*

Sub-

Subtracting five deg. from	A D B	23° 30′
There remains	a D B	18 30
Subtracting five deg. from		18 30
Remains	B D c	13 30

And ſo for the reſt, as follows in the Table.

a D B	18° 30′
B D c	13 30
B D e	08 30
B D f	03 30
B D g	01 30
B D h	06 30
B D i	11 30
B D k	16 30
B D l	21 30

In the Triangle a B D,

To find by what Latitude the Point (a) paſſes.

As Radius			Log. 10.00000
To tc.	B D	37° 35′	10.11371
So is ſc.	a D B	18 30	9.97696
To tc.	D a	39 04	10.09067

The Complement of D a 50 deg. 56 min. North, is the Latitude of the Point (a.)

After the ſame manner are found the Latitudes for the Points c, e, &c. in the ſubſequent Table.

	Long.	Lat.
A	00° 00′	50° 00
a	05 00	50 56
c	10 00	51 38
e	15 00	52 06
f	20 00	52 22
g	25 00	52 24
h	30 00	52 14
i	35 00	51 51
k	40 00	51 14
l	45 00	50 24
E	47 00	50 00

Fourthly, Having the Latitudes and Longitudes by which the Arch paſſes, you may find the Courſe and Diſtance from place to place by *Mercator*.

So to find the Courſe and Diſtance A a,

There is given both Latitudes, 50 deg. North, and 50 degrees 56 min. North.

And the Difference of Longitude, five degrees Weſt.

The Meridional Difference of Latitude is 87 minutes.

For

For the Courſe.

As Merid. Diff. Lat. —— 87′ ———— Log. 1.93952

To Radius ———— 10.00000
So is the Diff. of Long. 300 ———— 2.47712

To t. Courſe —— 73° 49′ ———— 10.53760

For the Diſtance.

As ſc. Courſe ———— 73° 49′ ———— Log. 9.44515

To the Difference of Latitude 56 ———— 1.74819
So is Radius ———— 10.00000

To the Diſtance ———— 200 ———— 2.30304

After the ſame manner you will find the Courſes and Diſtances a c, c e, *&c.* as they follow in the Table.

Places.	Courſes.	Diſt.
From A to a	N W 73° 49′	200
From a to c	N W 77 13	189
From c to e	N W 81 28	188
From e to f	N W 85 02	184
From f to g	N W 89 22	180
From g to h	S W 86 45	176
From h to i	S W 82 58	187
From i to k	S W 78 41	188
From k to l	S W 75 14	196
From l to E	S W 72 51	81

But in regard moſt of the Courſes afore-found, are ſo near the Weſt, you may ſail W. N. W. 917′, until you are in the Latitude 55° 51′ North; and then W. S. W. 917 min. further, you will arrive at your Port. By this means you will alter your Latitude almoſt ſix Degrees, and the Diſtance is but 52 more than that of a great Circle, and not above 22 min. more than the Parallel or Weſt Diſtance.

Problem II.

Two Places differing both in Latitude and Longitude.

Example.

Suppoſe the two Places to be one in the Latitude 36° North, the other in the Latitude 50° North, the Difference of Longitude between them 68° Eaſterly: I demand the Angles of Poſition, the Diſtance in the Arch, the Latitudes and Longitudes by which the Arch paſſes, and the Courſe and Diſtance from place to place, through thoſe Latitudes and Longitudes, according to the true Chart.

Let A repreſent the firſt Place, in the Lat. 36°.
E the ſecond, in the Lat. 50°.

Plate 11. *Fig.*13.

The Operation.

Firſt, To find the Angles of Poſition.

In the Triangle A D E.

AD	54° 00′	ADE	68° 00′
DE	40 00	$\frac{1}{2}$ ADE	34 00
Sum,	94 00	$\frac{1}{2}$ Sum,	47 00
Diff.	14 00	$\frac{1}{2}$ Diff.	07 00

As ſ $\frac{1}{2}$ Z cr^a. A D and D E 47° 00′ ———— Co. Ar. Log. 0.13587
To ſ. $\frac{1}{2}$ X cr^a. ——— 07 00 ———— 9.08589
So is tc. $\frac{1}{2}$ A D E ——— 34 00 ———— 10.17101
Tot. $\frac{1}{2}$ X VV A and E 13 52 ———— 19.39277

As

Co. Ar.

As ſc. ½ Z cr^2. A D and D E 47° 00′ ——— Log. 0.16622
To ſc. ½ X cr^2. ——— 07 00 ——— 9.99673
So is tc. ½ A D E ——— 34 00 ——— 10.17101

To t. ½ Z VV A and E 65 08 ——— 10.33398

½ Z VV 65° 08′
½ X VV 13 52

Sum, 79 00 A E D }
Diff. 51 16 D A E } The Angles of Poſition.

Secondly, To find the Diſtance.

In the Triangle A D E.

Co. Ar.

As ſ. A E D — 79° 00′ ——— Log. 0.00805
To ſ. A D — 54 00 ——— 9.90796
So is ſ. A D E 68 00 ——— 9.96716

To ſ. A E — 49 50 ——— x9.88317

The Diſtance is 49 deg. 50 min. which reduced into Minutes, makes 2990 minutes.

Thirdly, To find the Latitudes and Longitudes by which the Arch paſſes.

Firſt, Find the greateſt Latitude by which the Arch paſſes.

In the Right-angled Triangle A B D.

As Radius ——— Log. 10.00000

To ſ. A D — 54° 00′ ——— 9.90796
So is ſ. D A B 51 16 ——— 9.89213

To ſ. D B — 39 07 ——— x9.80009

D B is 39 deg. 07 min. whoſe Compl. 50 deg. 53 min. is the greateſt Latitude.

Secondly, To find the Vertical Angles A D B, and B D E.

In the Right-angled Triangle A B D.

As tc. B A D 51° 16′ —————— Log. 9.90423
To Radius ——————————
So is ſc. A D 54 00 —————————— 10.00000
9.76922
To tc. A D B 53 46 —————————— 9.86499

From — A D E 68° 00′
Subtract A D B 53 46
Remains B D E 14 14

Thirdly, To find the Latitudes by which the Arch paſſes at every five Degrees Longitude from A, you muſt reſolve the ſeveral Right-angled Triangles B D a, B D b, B D c, *&c.*

Subtracting five deg. from A D B 53° 46′
There remains A D b 48 46
Subtracting five deg. from 48 46
Remains b D B 43 46

So of the reſt in the following Table.

B D a	48 46	*B D h*	13 46
B D b	43 46	*B D i*	08 46
B D c	38 46	*B D k*	03 46
B D d	33 46	*B D l*	01 14
B D e	28 46	*B D m*	06 14
B D f	23 46	*B D n*	11 14
B D g	18 46		

In the Triangle *a D B*, to find by what Latitude the Arch paſſes at the Point *a*.

As t. *D B* —— 39° 07′ —————— Log. 9.91018

To Radius —————————— 10.00000
So is ſc. *a D B* 48 46 —————— 9.81897

To tc. *a D* 50 59 —————— 9.90879

Whoſe Compl. 39° 01′ is the Latitude at *a*.

After the ſame manner, are found the Latitudes of the ſeveral Points *b*, *c*, *d*, *e*, *&c.* as in the ſubſequent Table.

	Latitude.	Long.
A	36° 00′	00′
a	39 01	05
b	41 36	10
c	43 47	15
d	45 37	20
e	47 09	25
f	48 22	30
g	49 20	35
h	50 03	40
i	50 33	45
k	50 49	50
l	50 52	55
m	50 43	60
n	50 20	65
E	50 00	68

Fourthly; Having thus the Latitudes and Longitudes of the Arch, you may find the Courſes and Diſtances from Place to Place, according to *Mercator*.

So to find the Courſe and Diſtance *A a*.

Both Latitudes are 36 deg. and 39 deg. 01 min.

The Difference of Longitude 5 deg.

The proper Difference of Latitude 181 min.

The Merid. Difference of Latitude 228 Minutes.

For the Courſe.

As Merid. Diff. Lat. 228 min. —————— Log. 2.35793

To Radius —————————— 10.00000
So is the Diff. Longitude 300 min. —————— 2.47712

To t. Courſe 52° 45′ —————— 10.11919

For

For the Diſtance.

As ſc. Courſe 52° 45′ —————— Log. 9.78197

To Diff. Lat. —— 181 —————— 2.25768

So is Radius —————— 10.00000

To the Diſtance —— 299 —————— 2.47571

After the ſame manner you may find the Courſes and Diſtances, *a b*, *b c*, *c d*, &c. as they follow in the Table.

Places.	Courſes.				Diſtances. min.
From *A* to *a*	N	E	52°	45′	299
From *a* to *b*	N	E	55	54	176
From *b* to *c*	N	E	59	10	255
From *c* to *d*	N	E	62	40	239
From *d* to *e*	N	E	66	05	226
From *e* to *f*	N	E	70	01	212
From *f* to *g*	N	E	73	39	202
From *g* to *h*	N	E	77	35	199
From *h* to *i*	N	E	81	05	193
From *i* to *k*	N	E	85	14	192
From *k* to *l*	N	E	89	02	177
From *l* to *m*	S	E	87	19	192
From *m* to *n*	S	E	83	09	193
From *n* to *D*	S	E	80	13	117

CHAP. VIII.

The Doctrine of the Sphere: Containing ſundry Aſtronomical Problems, uſeful in the **Art of Navigation.**

SECT. I.

Aſtronomical Definitions.

THE *Poles of the World* are two fixed Points in the Heavens, diametrically oppoſite one to another, the one viſible in our Hemiſphere, called the North, or *Artick Pole*, noted with the Letter P. *Plate* 2. *Fig.* 14.

The other not ſeen of us, being in the lower Hemiſphere, called the South, or *Antartick Pole*, noted with S.

The *Axis of the World* is an *imaginary Line* drawn from Pole to Pole, about which the *Diurnal Motion* is performed from Eaſt to Weſt.

The *Meridians* are Great Circles concurring and interſecting one another in the Poles of the World; as P E S, and P c S.

The *Equinoctial*, or *Equator*, is a *Great Circle*, 90 d. diſtant from the Poles of the World, cutting the *Meridians* at Right-Angles, and dividing the World into *two Parts*, called the *North* and *South Hemiſphere*; as E♎Q.

The *Ecliptick* is a *Great Circle*, croſſing the *Equinoctial* in the two oppoſite Points *Aries* and *Libra*, and making an Angle therewith called its *Obliquity*) of 23 deg. 30 min. repreſented by ♋ ♎ ♑.

This Circle is divided into 12 Signs, each containing 30 deg. whoſe Names and Characters follow.

Aries	♈	Which are *Northern Signs.*
Taurus	♉	
Gemini	♊	
Cancer	♋	
Leo	♌	
Virgo	♍	
Libra	♎	Theſe are *Southern Signs.*
Scorpius	♏	
Sagittarius	♐	
Capricornus	♑	
Aquarius	♒	
ſces	♓	

The *Zodiack* is a Zone or Girdle, having eight Degrees of Latitude on either ſide of the *Ecliptick*, in which ſpace the Planets make their Revolutions. 'Tis divided and diſtinguiſhed by the twelve Signs.

The *Colures* are two *Meridians*, dividing the *Equinoctial* and the *Ecliptick* into four equal parts; one of theſe paſſes by the *Equinoctial* Points, *Aries* and *Libra*, and is called the *Equinoctial Colure*, as P ♎ S.

The other by the beginning of *Cancer* and *Capricorn*, called the *Solſtitial Colure*, P ♋, S ♑.

The *Poles of the Ecliptick* are two Points, 23° 30′ diſtant from the Poles of the World, as I and K.

The *Tropicks* are two ſmall Circles, parallel to the *Equinoctial*, and diſtant therefrom 23° 30′, limiting the Sun's greateſt Declination.

The *Northern Tropick* paſſes by the beginning of *Cancer*, and is called the *Tropick of Cancer*; as ♋ a D.

The *Southern Tropick* paſſes by the beginning of *Capricorn*, and is called the *Tropick of Capricorn*; as A b ♑.

The *Polar Circles* are two ſmall Circles parallel to the *Equinoctial*, and diſtant therefrom 66 deg. 30 min. and from the Poles of the World, 23 deg. 30 min.

That which is adjacent to the North Pole, is called the *Artick Circle*, as G d I.

And the other the *Antartick Circle*, as K d M.

The *Zenith* and *Nadir* are two Points diametrically oppoſite.

The *Zenith* is the vertical Point, or the Point right over our Heads, as Z.

The *Nadir* is directly oppoſite thereto, as N.

The *Azimuths*, or *Vertical Circles*, are great Circles of the Sphere, concurring and interſecting each other in the *Zenith* and *Nadir*; as Z f N.

The *Horizon* is a great Circle 90 deg. diſtant from the *Zenith* and *Nadir*, cutting all *Azimuths* at Right-Angles, and dividing the World into two equal Parts, the *Upper* and viſible *Hemiſphere*, and the *Lower* and inviſible: This Circle is repreſented by H ♎ R.

The *Meridian* of a Place, is that *Meridian* which paſſes by the *Zenith* and *Nadir* of the Place; as P Z S N.

The *Almicanthars*, or *Parallels of Altitude*, are ſmall Circles, parallel to the *Horizon*, imagined to paſs through every Degree and Minute of the *Meridian*, between the *Zenith* and *Horizon*; as B a F.

Parallels of Latitude, or *Declination*, are ſmall Circles, parallel to the *Equinoctial*: They are called *Parallels of Declination*, in reſpect of the Sun or Stars in the Heavens; and *Parallels of Latitude*, in reſpect to any Place upon the Earth.

The *Latitude of a Place*, is the Height of the Pole above the *Horizon*, or the Diſtance between the *Zenith* and the *Equinoctial*.

The *Latitude of a Star*, is the Arch of a Circle, contained between the Center of a Star, and the *Ecliptick* Line; this Circle making Right-Angles with the *Ecliptick*, and is counted either Northward or Southward according to the Situation of the Star.

Longitude on the Earth is meaſured by an Arch of the *Equinoctial*, contained between the primary *Meridian*, (or *Meridian* of that Place where Longitude is aſſigned to begin) and the Meridian of any other Place counted always Eaſterly.

The *Longitude* of a Star, is that part of the *Ecliptick* which is contained between the Star's Place in the *Ecliptick*, and the beginning of *Aries*, counting them according to the Succeſſion of the Signs.

Altitude of the Sun or Stars, is the Arch of an *Azimuth* contained betwixt the Center of the Sun or Star and the Horizon.

Aſcenſion is the riſing of any Star, or any part of the *Equinoctial* above the *Horizon*; and *Deſcenſion* is the ſetting thereof.

Right-Aſcenſion is the Number of Degrees and Minutes of the *Equinoctial*, (counted from the beginning of *Aries*) which cometh to the *Meridian* with the Sun or Stars, or with any portion of the *Ecliptick*.

Oblique-Aſcenſion is an Arch of the *Equinoctial* between the beginning of *Aries*, and that part of the *Equinoctial* that riſeth with the Center of a Star, or with any portion of the *Ecliptick*, in an *Oblique-Sphere*.

Oblique-Deſcenſion, is that part of the *Equinoctial* which ſets therewith.

Aſcenſional Difference is an Arch of the *Equinoctial*, being the Difference between the *Right* and *Oblique Aſcenſion*.

The *Amplitude* of the Sun or Star is the Diſtance of the riſing or ſetting thereof, from the Eaſt or Weſt Point of the *Horizon*.

The *Parallax* is the Difference between the true and apparent Place of the Sun or Star; ſo the true Place in reſpect of Altitude is in the Line **A C E**, or **A D G**, the Sun or Star being at C or D.

Plate 3. *Fig.* 15.

And the apparent Place in the Line B C F, or B D H.

So the Angles of *Parallax* are A C B, or E C F; and A D B, or G D H.

In this Scheme, A B K repreſents a Quadrant on the Earth's Superficies.

A the Center of the Earth.

B any Point of the Earth's Surface.

Refraction

Fig: 12

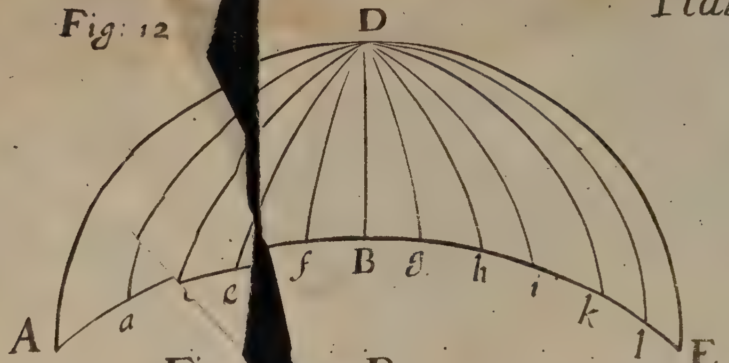
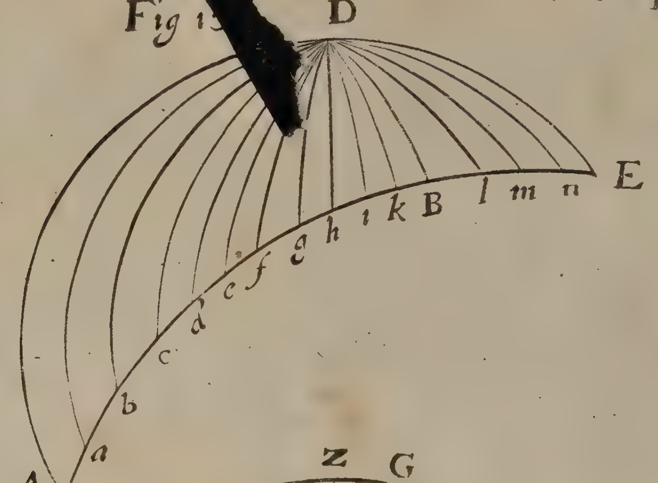


Fig 13



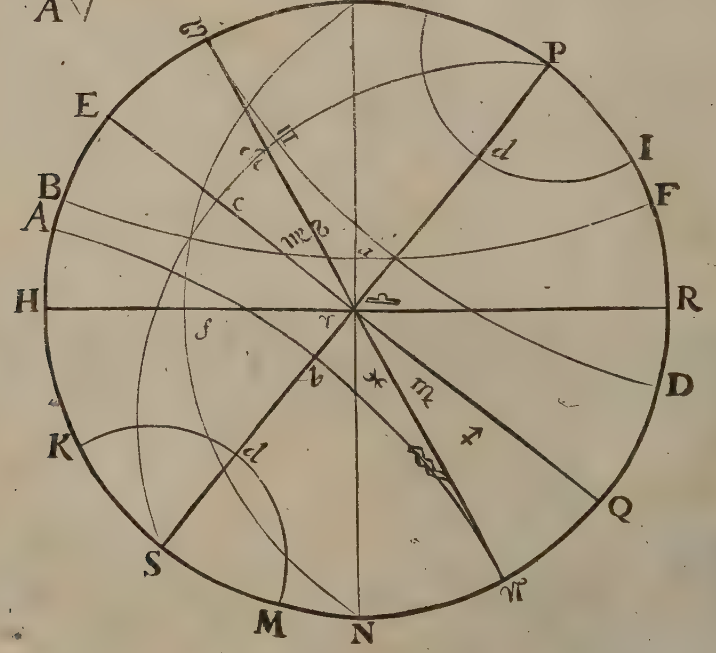


Fig: 14

nullar at William
Tetr Houſe

Refraction of the Stars, obſerved by Tycho.

Alt.	Refract.	
0°	30′	00″
1	21	30
2	15	30
3	12	30
4	11	00
5	10	00
6	9	00
7	8	15
8	6	45
9	6	00
10	5	30
11	5	00
12	4	30
13	4	00
14	3	30
15	3	00
16	2	30
17	2	00
18	1	15
19	0	30
20	0	00

The *Refraction* is cauſed by the *Atmoſphere*, or vaporous Thickneſs of the Air near the Earth's ſuperficies, whereby the Sun and Stars ſeem always to riſe ſooner, and ſet later than really they do.

In the Latitude of 55 Degrees and thereabouts, it is allowed to be as follows in the Table, although it varies by the Weather.

And in more Nothern Parts it hath been obſerved to be greater.

The Uſe whereof is this;

Suppoſe the Altitude obſerved were 10 Degrees; the correſpondent Refraction is 5 min. 30 ſeconds, which ſubtracted from 10 deg. the Remainder 9 deg. 54 min. 30 ſeconds, is the true Altitude.

SECT. II.

Aſtronomical Problems.

Problem I.

THe Sun's Place in the *Ecliptick*, and greateſt Declination being given, to find his preſent Declination.

Example 1.

The Sun's Place begin in 26° 41′ of *Taurus*, and his greateſt Declination, or the Angle of the *Ecliptick* with the *Equinoctial*, 23° 30′; to find the preſent Declination. *Plate* 3. *Fig.* 16.

In the Right-angled Spherical Triangle ♈ B C, there is given ♈ C the *Hypotenuſe* 56° 41′, the Sun's Diſtance from *Aries*, and the Angle B ♈ C, the greateſt Declination, (by the *9th* Caſe) to find the oppoſite Leg B C, the Sun's preſent Declination.

Therefore the Proportion and Operation is ;

As Radius ——————————— Log. 10.00000

To ſ. B ♈ C 23° 30′, the Sun's greateſt Declinat. —— 9.60070
So is ſ. ♈ C 56 41, the Sun's Diſtance from ♈ —— 9.92202

To ſ. BC 19 28, the preſent Declination N. —— 19.52272

Note; That the Sun's Diſtance is always accounted from the neareſt of the Equinoctial Points, *Aries* or *Libra*: therefore if the Sun be in the Northern Signs, *Aries*, *Taurus*, or *Gemini*; or in the Southern Signs, *Capricornus*, *Aquarius*, or *Piſces*, his Diſtance is computed from *Aries*.

But if his Place be in the Northern Signs, *Cancer*, *Leo*, or *Virgo*; or in the Southern Signs, *Libra*, *Scorpio*, or *Sagittarius*, 'tis reckoned from *Libra*.

If the Sun be in the Northern Signs, his Declination is *Northerly*; if in the Southern Signs, *Southerly*.

Example 2.

The Sun's Place is 22° 12′ of *Aquarius*, his greateſt Declination (as before) 23° 30′; to find his preſent Declination.

Plate 3. *Fig.* 16.

The Sun's Diſtance from *Aries*, is 37 deg. 48 min.

The Operation.

In the Right-angled Triangle ♈ DF.

As Radius		Log.	10.00000
To ſ. D♈F	23° 30′,	the greateſt Declination,	9.60070
So is ſ. ♈F	37 48,	the Diſtance from *Aries*	9.78739
To ſ. DF	14 08,	the preſent Declination S.	~~1~~9.38809

You may find the Sun's Place by the Tables in *Aſtronomia Carolina.*

Problem II.

The Sun's Place given, to find his Right-Aſcenſion.

Note.

The Sun's greateſt Declination is concluded by Mr. *Street*, in his *Caroline Tables*, to be 23° 30′, therefore 'tis always given.

Example 1.

The Sun's Place is 26° 41′ of *Taurus*;
To find the Right-Aſcenſion.

Plate 3. *Fig.* 16.

In the Right-angled Triangle ♈ BC, there is given the *Hypotenuſe* ♈C 56 deg. 41 min. the Sun's Place from *Aries*.

The Angle B♈C, 23 deg. 30 min. the greateſt Declination, (by the 6*th* Caſe) to find the adjacent Leg ♈ B, the Right-Aſcenſion.

The Operation.

As Radius ———————————————— Log. 10.00000

To t. ♈ C 56° 41′, the Sun's Long. from ♈ 10.18224
So is ſc. B ♈ C 23 30, the greateſt Declination, 9.96240

To t. ♈ B 54 22, the Right-Aſcen. from ♈ 10.14464

Example 2.

The Sun's Place is 22° 12′ of *Aquarius*;
To find the Right Aſcenſion. *Plate* 3. *Fig.* 16.

The Operation.

In the Right-angled Triangle ♈ D F.

As Radius ———————————————— Log. 10.00000

To t. ♈ F — 37° 48′, the Sun's Long. from ♈ 9.88968
So is ſc. D ♈ F 23 30, the greateſt Declination, 9.96231

To t. ♈ D — 35 25, the Right-Aſcen. from the next Equinoctial Point. 19.85199

This Proportion finds the Right-Aſcenſion from the neareſt Equinoctial Point, as you account the Longitude in the Operation. But the Right-Aſcenſion is to be reckoned from *Aries*, according to the Succeſſion of the Signs.

Therefore in this laſt *Example*, the Complement of 35° 25′, to 360, which is 324° 35′, is the Right-Aſcenſion ſought.

Problem III.

The Sun's Declination given, to find his Place or Longitude from *Aries*.

Example 1.

The Sun's Declination is 19° 30′ North, encreaſing.
To find his Place.

Plate 3. *Fig.* 16.

In

The Folio Book 1764

In the Right-angled Triangle ♈ B C,

There is given the Leg B C 19° 30′, the Sun's preſent Declination.

The oppoſite Angle B ♈ C 23° 30′, the greateſt Declination.

And the *Hypotenuſe* ♈ C required, (by the 10*th* Caſe) being the Sun's Diſtance from *Aries* or *Libra.*

The Operation.

As ſ. B ♈ C 23° 30′, the greateſt Declination,——Log. 9.60070

To Radius ———————————————— 10.00000
So is ſ. B C 19 30, the preſent Declination,——— 9.52349

To ſ. ♈ C 56 50 ———————————— 9.92279

Which 56 50 reduced into Signs, is 1^s 26° 50′,
or 26 50 of *Taurus.*

If the Sun's Declination be North, and encreaſing, this Proportion finds the Sun's Diſtance from *Aries*; if decreaſing, from *Libra*, in the Northern Signs.

If the Sun's Declination be South, and encreaſing, from *Libra*; if decreaſing, from *Aries*, among the Southern Signs.

Example 2.

The Sun's Declination is 14° 10′ South, decreaſing.
To find the Longitude from *Aries.*

Plate 3. *Fig.* 16.

The Operation.

In the Triangle ♈ D F.

As ſ. D ♈ F 23° 30′, the greateſt Declination, ——— 9.60070

To Radius ———————————————— 10.00000
So is ſ. D F 14 10, the preſent Declination,——— 9.38871

To ſ. ♈ F 37 52, the Diſtance from *Aries* ——— 9.78801

The Compl. of 37 deg. 52 min. to 360 deg. is 322 deg. 08 min. Which reduced into Signs, is 10^s 22° 08′, or 22° 08′ of *Aquarius.*

Problem IV.

The Sun's Declination given, to find the Right-Aſcenſion.

Example 1.

The Sun's Declination is 19° 30′ North, increaſing.
To find his Right-Aſcenſion.

Plate 3. *Fig.* 16.

In the Right-angled Triangle ♈ B C,
There is given the Leg BC 19° 30′, the Sun's preſent Declination.
And the oppoſite Angle B ♈ C 23° 30′, the greateſt Declination, (by the 1*ſt* Caſe) to find the Leg ♈ B, the Right-Aſcenſion.

As Radius	10.00000
To tc. B ♈ C 23° 30′, the greateſt Declination,	10.3617
So is t. B C 19 30, the preſent Declination,	9.54915
To ſ. ♈ B — 54 32, the Right-Aſcen. from ♈	~~1~~9.91085

The ſame Caution which was given for the right accounting the Sun's Place in the third *Problem*, ſerves for the Right-Aſcenſion; only as that was given in Signs, Degrees and Minutes, this muſt be given in Degrees and Minutes from *Aries.*

Example 2.

The Sun's Declination is 14° 10′ South, decreaſing.
To find the Right Aſcenſion.

Plate 3. *Fig.* 16.

27′ 40
2′ 20

The Operation.

In the Right-angled Triangle ♈ D F.

As Radius ——————————————— Log. 10.00000

To tc. D ♈ F 23° 30′, the Sun's greateſt Declinat. 10.36170
So is t. D F 14 10, the preſent Declination ——— 9.40212

To ſ. ♈ F 35 29, the Right Aſcenſion ——— 19.76382

The Complement of 35 deg. 29 min. to 360 deg. is 224 deg. 31 min. the Right Aſcenſion from *Aries*.

Problem V.

The Latitude of a Place, and the Sun's Declination being given, to find the Aſcenſional Difference.

Example.

In the Latitude 51 deg. 32 min. the Sun's Declination being 20 deg. 12 min. to find the Aſcenſional Difference.

In the Right-angled Triangle a b c,

There is given the Leg b c 20 deg. 12 min. the Sun's Declination, and the oppoſite Angle b a c 38 deg. 28 min. the Compl. of the Latitude, or the Angle between the Equinoctial and Horizon; (by the firſt Caſe) to find the other Leg a b, the Aſcenſional Difference.

Plate 3. Fig. 17.

The Operation.

As Radius ——————————————— Log. 10.00000

To tc. b a c, 38° 28′ the Compl. of the Lat. ——— 10.09991
So is t. b c, 20 12, the Declination ——————— 9.56576

To ſ. a b 27 35, the Aſcenſional Difference ——— 19.66567

Problem VI.

To find the Oblique Aſcenſion or Deſcenſion.

Firſt, Find the *Aſcenſional Difference* by the fifth Problem, and the *Right Aſcenſion* by the fourth Problem.

Secondly, If the Sun's Declination be Northerly, the *Aſcenſional Difference* ſubtracted from the *Right Aſcenſion*, leaves the *Oblique Aſcenſion*; and added to the *Right Aſcenſion*, gives the *Oblique Deſcenſion*.

Thirdly, If the Sun's Declination be Southerly, the *Aſcenſional Difference* added to the *Right Aſcenſion*, gives the *Oblique Aſcenſion*; and ſubtracted therefrom, leaves the *Oblique Deſcenſion.*

Note.

If the *Right Aſcenſion* be leſs than the *Aſcenſional Difference*, add 360 deg. to the *Right Aſcenſion*, and then ſubtract it therefrom; Or if the Sum of the *Right Aſcenſion* and *Aſcenſional Difference*, exceeds 360 deg. reject 360 deg. the Remainder is the *Oblique Aſcenſion*, or *Deſcenſion* required.

Problem VII.

To find the Time of the *Sun's Riſing* or *Setting*, and conſequently the Length of the Day or Night.

Firſt, Find the *Aſcenſional Difference* by the fifth Problem, which reduced into Hours and Minutes of Time, by allowing for every 15 deg. one hour, and for every degree leſs than 15, 4 min. of Time, and for every 15 min. one minute of Time.

Secondly, If the Sun's Declination be Northerly, the *Aſcenſional Difference* added to ſix hours, gives the Time of *Sun-ſetting*.

And ſubtracted therefrom, leaves the Time of *Sun-riſing*.

On the contrary, If the Sun's Declination be Southerly, the *Aſcenſional Difference* added to ſix hours gives the Time of *Sun-riſing*, and ſubtracted therefrom, the Time of *Sun-ſetting*.

Thirdly, If you double the Time of *Sun ſetting*, it gives you the *Length* of the Day; and the Time of *Sun-riſe* doubled, the *Length* of the Night.

Example 1.

In the Latitude 51 deg. 32 min. North, the *Sun's Declination* 20 deg. 12 min. North.

And the *Aſcenſional Difference* by the fifth Problem is 27 deg. 35 min. which reduced into Time makes 1 hour 50 minutes.

	ho.	min.
Therefore the Time of *Sun-ſetting* is	7	50
The Time of *Sun-riſing*,	4	10
The Length of the Day,	15	40
The Length of the Night,	8	20

Example 2.

In the Latitude 51 deg. 32 min. the Declination 20 deg. 12 min. South.

And the *Aſcenſional Difference* is 27 deg. 35 min. which makes (as before) 1 hour 50 minutes of Time.

	ho.	min.
The Time of *Sun-riſing*,	7	50
The Time of *Setting*,	4	10
The Length of the Day,	8	20
The Length of the Night,	15	40

Problem VIII.

The Latitude of a Place, and the Sun's Declination being given, to find the Sun's *Amplitude*.

Example.

In the Latitude 51 deg. 32 min. the Sun's Declination being 20 deg. 12 min. to find the *Amplitude*.

In the Right-angled Triangle a b c, there is given the Leg b c 20 deg. 12 min. and the oppoſite Angle b a c 38 deg. 28 min. (by the tenth Caſe) to find the *Hypotenuſe* a c the *Amplitude*.

Plate 3. *Fig.* 17.

The Operation.

As ſ. b a c, 38° 28′ the Compl. of the Lat.	9.79383
To Radius	10.00000
So is ſ. b c 20 12 the Declination	9.53819
To ſ. a c 33 43, the *Amplitude*,	9.74436

If the Sun's Declination be Northerly, the Amplitude is to the Northward of the Eaſt or Weſt; If the Declination be Southerly, to the Southward.

Problem IX.

The Latitude of a Place, and the Sun's Declination being given, to find at what time the Sun ſhall be due Eaſt or Weſt.

Example.

In the Latitude 51 deg. 32 min. North, the *Sun's Declination* 20 deg. 12 min. North.

To find at what time the Sun ſhall be due Eaſt or Weſt.

In the Right-angled Triangle a d e, there is given the Leg d e 20 deg. 12 min. and the oppoſite Angle d a e, 51 deg. 32 min. (by the firſt Caſe) to find the Leg a e, the Time from ſix.

Plate 3. *Fig.* 17.

The Operation.

As Radius — Log.	10.00000
To tc. d a e 51° 32′ the Latitude	9.90009
So is t. d e 20 12, the Declination	9.56576
To ſ. a e 16 59, the Diſtance from ſix	19.46585

Which being reduced into Time makes one hour, eight minutes *ferè*, which added to ſix hours, gives 7 hours and eight min. at which time the Sun comes to the Eaſt; and ſubtracted from 6 hours, leaves 4 hours 52 min. the time of his being in the *Weſt Azimuth*, or *Prime Vertical.*

Problem X.

The Latitude of the Place, and the Sun's Declination being given; to find the Sun's Altitude, being in the Eaſt or Weſt *Azimuth*, or *Prime Vertical.*

Example.

In the Latitude 51 deg. 32 min. North, the Declination 20 deg. 12 min. North, to find the Sun's Altitude being due Eaſt or Weſt.

In the Right-angled Triangle a d e, there is given the Leg d e 20 deg. 12 min. and the oppoſite Angle, d a e 51 deg. 32 min. (by the tenth Caſe) to find the *Hypotenuſe* a d.

Plate 3. *Fig.* 17.

The Operation.

As ſ. d a e 51° 32′ the Latitude ——————— 9.89374

To Radius ——————————————— 10.00000

So is ſ. d e 20 12, the Declination, ————— 9.53819

To ſ. a d 26 10, the Alt. in the *Prime Vert.* ——— 9.64445

Problem XI.

The Latitude of a Place, and the Sun's Declination being given, to find his Altitude at ſix of the Clock.

Example.

In the Latitude 51 deg. 32 min. North, the Declination 23 deg. 30 min. North, to find the Sun's Altitude at ſix.

In the Right-angled Triangle a b c, there is given the *Hypotenuſe* a c 23 deg. 30 min. and the Angle b a c, 51 deg. 32 min. (by the ninth Caſe) to find the oppoſite Leg b c.

Plate 3. Fig. 18.

The Operation.

As Radius ——————————— Log. 10.00000

To ſ. a c 23° 30′ the Declination ——————— 9.60070
So is ſ. b a c 51 32, the Latitude ——————— 9.89374

To ſ. b c 18 11, the Altitude at ſix ——————— 19.49444

Problem XII.

The Latitude of a Place, and the Sun's Declination being given, to find the *Azimuth* at ſix.

Example.

In the Latitude 51 deg. 32 min. North, the Declination 23 deg. 30 min. North, to find the Sun's *Azimuth* at ſix of the Clock.

In the Right-angled Triangle a b c, there is given the *Hypotenuſe*, a c, 23 deg. 30 min. and the Angle b a c, 51 deg. 32 min. (by the ſixth Caſe) to find the adjacent Leg a b.

The Operation.

As Radius ——————————— Log. 10.00000

To t. a c 23° 30′ the Declination ——————— 9.63830
So is ſc. b a c 51 32, the Latitude ——————— 9.79383

To t. a b 15 08, the *Azimuth* from the Eaſt ——— 19.43213

Problem XIII.

The Latitude of the Place, the Sun's Altitude and Declination being given, to find his *Azimuth*.

Example.

Example 1.

In the Latitude 51 deg. 32 min. North, the Declination 23 deg. 30 ~~min.~~ North, the Altitude 49 deg. 40 min. To find the Sun's *Azimuth*.

In the Oblique-angled Triangle D P Z, there is given, the three Sides, Z P 38° 28′ the Compl. of the Latit. P D 66° 30′, the Compl. of the Declination, or the Sun's Diſtance from the elevated Pole, and D Z 40° 20′, the Comp. of the Altitude, (by the 11*th* Caſe) to find the Angle D Z P, the Sun's *Azimuth* from the North.

Plate 3. *Fig.* 18.

The Operation.

The	Z D	40° 20′	Sine ——— Co. Ar.	0.18894
Legs	Z P	38 28	Sine ——— Co. Ar.	0.20614
The Baſe	D P	66 30	½ Sum 72° 39′ Sine Log.	9.97978
Sum		145 18,	Rem. 06 00 Sine	9.02992
½ Sum		72 39	——— Sum,	~~1~~9.40481
Rem.		06 09	ſc. 59 44 ½ Sum,	9.70240
Which doubled,			59 44 produces	
The Sun's *Azimuth*			119 28 from the North.	

Example 2.

In the Lat. 31° 52′ North, the Sun's Declination is 15° 16′ South, and his Altitude 19° 37′; to find his *Azimuth* from the North.

Plate 4. *Fig.* 19.

The Operation.

In the Triangle D P Z,
There is given P Z 38° 28′,
D Z 70° 23′, D P 105° 16′, and D Z P required.

The

The ZD	70° 23′	Sine		——— Co. Ar.	0.02597
Legs ZP	38 28	Sine		——— Co. Ar.	0.20617
The Baſe DP	105 16	½ Sum	107° 03′	Sine Log.	9.98048
Sum	214 07,	Rem.	01 47	Sine	8.49304
½ Sum	107 03,	———		——— Sum	$\cancel{1}8.70566$
Rem.	01 47	ſc.	76 59	½ Sum	9.35283
Which doubled,			76 59	produces	
The Sun's *Azimuth*			153 58	from the North.	

Example 3.

In the Latit. 51 deg. 32 min. South, the Sun's Declination 23 deg. 30 min. South, and his Altitude 49 deg. 40 min. to find his *Azimuth* from the South.

In the Triangle DPZ, P muſt repreſent the South Pole; then there is given PZ 38° 28′, the Compl. of the Latit. DZ 40° 20′, the Compl. of the Altitude; PD 66° 30′, the Compl. of the Declination, or the Sun's Diſtance from the elevated (or South) Pole; to find PZD, the Sun's *Azimuth* from the South.

Plate 3. *Fig.*18.

The Operation is the ſame with the firſt *Example*; only as the *Azimuth* there was accounted from the North, this finds it from the South part of the Horizon, which is 119 deg. 28 min.

Example 4.

In the Lat. 51 deg. 32 min. South, the Sun's Declination is 15 deg. 16 min. North, and his Altitude 19 deg. 37 min. to find his *Azimuth* from the South.

Plate 4. *Fig.* 19.

In the Triangle DPZ, P repreſents the South Pole, as in the former Example.

Then there is given P Z 38° 28′, D Z 70° 23′, P D 105° 16′, and D Z P required.

The Operation is the ſame with the ſecond *Example*, only the *Azimuth* found is to be accounted from the South, which will be found 153 deg. 58 min.

Problem XIV.

The Latitude of the Place, the Sun's Declination and Altitude being given, to find the Hour of the Day.

Example 1.

In the Latitude 51 deg. 32 min. North, the Sun's Declination is 23 deg. 30 min. North, and his Altitude 49 deg. 40 min. to find the Hour from Noon.

In the Triangle D P Z, there is given P Z 38 deg. 28 min. D Z 40 deg. 20 min. D P *66* deg. 30 min. and D P Z the Hour from Noon required.

Plate 3. *Fig.* 18.

The Operation.

The Legs D P	66° 30′	Sine		Co. Ar.	0.03760
P Z	38 28	Sine		Co. Ar.	0.20617
The Baſe D Z	40 20	½ Sum	72° 39′	Sine Log.	9.97978
Sum	145 18	Rem.	32 13	Sine	9.72683
½ Sum	72 39			Sum	19.95038
Rem.	32 13	Sc.	19 11	½ Sum	9.97519

The Double of 19 deg. 11 min. is 38 deg. 22 min. which being reduced into Time, gives 2 hours 33 min. from Noon; ſo that the hour of the Day is either 2 hours 33 min. Afternoon, or 9 hours 27 min. before Noon.

Example 2.

In the Latitude 51 deg. 32 min. North, the Sun's Declination 15 deg. 16 min. South, and his Altitude 19 deg. 37 min. to find the Hour P. M. or Afternoon.

In the Triangle D P Z, there is given the three Sides, P Z 38° 28′, D Z 70° 23′, P D 105° 16′, and D P Z required.

Plate 4. *Fig.* 19.

The Operation.

The ⎧ PD	105° 16′	Sine		Co. Ar.	0.01560
Legs ⎩ PZ	38 28	Sine		Co. Ar.	0.20617
The Baſe DZ	70 23	½ Sum	107° 03′.	Log.	9.98048
Sum	214 07	Rem.	36 40		9.977609
½ Sum	107 03				19.97834
Rem.	36 40	Sc.	12 44		9.98917

Which doubled, produces 25 deg. 28 min. and that reduced into Time, makes 1 hour 42 min. *ferè.*

Problem XV.

The Latitude of a Place, the Sun's Declination, and the Hour of the Day given, to find the Sun's Altitude.

Example.

In the Lat. 51 deg. 32 min. North, the Sun's Declination is 23 deg. 30 min. North; the Hour, 1 hour 53 min. Afternoon.
To find the Sun's Altitude.

1 Hour 53 minutes reduced, make 28 deg. 15 min.

In the Triangle D P Z, there is given the two Sides, P Z 38 deg. 28 min. D P 66 deg. 30 min. and the contained Angle D P Z 28 deg. 15 min. and the third Side D Z required.

Plate 3. Fig. 18.

The Operation.

As Radius ——————————— Log. 10.00000

To ſc. D P Z 28° 15′ the contained Angle ——— 9.94492
So is t. P Z 38 28 the leſſer Side ——— 9.90009

To t. —— 34 59 a fourth Arch ——— ~~1~~9.84501

From the other Side P D 66° 30′
Subtract the fourth Arch 34 59

The Rem. is the Reſidual Arch 31 31

Co. Ar.
As ſc. ——— 34° 59′ the fourth Arch ——— 0.08655
To ſc. ——— 31 31 the Reſidual Arch ——— 9.93069
So is ſc. P Z 38 28 the leſſer Side ——— 9.89374

To ſc. D Z 35 27 the Side ſought ——— ~~1~~9.91098

Whoſe Compl. 54 deg. 33 min. is the Altitude required.

Problem XVI.

The Latitude of a Place, the Sun's Declination, and the Hour given, to find the Sun's *Azimuth.*

Example.

In the Latitude 51 deg. 32 min. North, the Sun's Declination is 15 deg. 16 min. South, and the Hour, 10 hour 18 min. in the Morning; to find the Sun's *Azimuth.*

The Time from Noon is 1 hour 42 min.
Which reduced, is 25 deg. 30 min.

In the Triangle DPZ, there is given the two Sides PZ 38 deg. 28 min. PD 105 deg. 16 min. and the contained Angle DPZ 25 deg. 30 min. to find one of the oppoſite Angles, *viz.* PZD.

Plate 4. Fig. 19.

The Operation.

PD 105° 16′
PZ 38 28

Sum 143 44 ½ Sum 71° 52′ } DPZ 25° 30′
Diff. 66 48 ½ Diff. 33 24 } the half 12 45

Co. Ar.
As ſ. ½ Z cr^{a}. DP and PZ 71° 52′ ———— 0.02212
To ſ. ½ X cr^{a}. ———— 33 24 ———— 9.74074
So is tc. ½ DPZ ———— 12 45 ———— 10.64536

To t. ½ X VV PDZ and PZD 68 39 ———— 10.40822

Co. Ar.
As ſ. ½ Z cr^{a}. DP and PZ ———— 71° 52′ ———— 0.50692
To ſc. ½ X cr^{a}. ———— 33 24 ———— 9.92161
So is tc. ½ DPZ ———— 12 45 ———— 10.64536

To t. ½ Z VV PDZ and PZD 85 10 ———— 11.07389

½ S VV 85° 10′
½ X VV 68 39

Sum 153 49 DZP required.

Which is the Sun's *Azimuth* from the North.

Problem XVII.

The Latitude of a Place, the Sun's Altitude and *Azimuth* given, to find the Hour.

Example.

Example.

In the Latitude 51 deg. 32 min. the Sun's Altitude 49 deg. 40 min. his *Azimuth* 119 deg. 44 min. from the North; to find the Hour Afternoon.

In the Triangle DPZ, there is given the two Sides DZ 40 deg 20 min. PZ 38 deg. 28 min. and the contained Angle DZP, 119 deg. 44 min. and the oppoſite Angle DPZ required.

Plate 3. *Fig.* 18.

The Operation.

DZ 40° 20′
PZ 38 28

Sum 78 48 ½ Sum 39° 24′ } DZP 119° 44′
Diff. 01 52 ½ Diff. 00 56 } the half 59 52

			Co. Ar.
As ſ. ½ Z cr^{a}. DZ and PZ	39°	24′	0.19741
To ſ. ½ X cr^{a}.	00	56	8.21189
So is tc. ½ DZP	59	52	9.76377
To t. ½ X *VV* PDZ and DPZ	00	51	18.17307

			Co. Ar.
As ſc. ½ Z cr^{a}. DZ and PZ	39°	24′	0.11197
To ſc. ½ X cr^{a}.	00	56	9.99994
So is tc. DZP	59	52	9.76377
To t. ½ Z *VV* PDZ and DPZ	36	54	19.87568

½ Z *VV* 36° 54′
½ X *VV* 00 51

Sum 37 45 DPZ required.

Note, DPZ is the greater Angle, becauſe oppoſite to the greater Side DZ; 37 deg. 45 min. reduced, makes the Time 2 hours 31 min. Afternoon.

Problem

Problem XVIII.

The Latitude and Longitude of a fixed Star being given, to find the *Right Aſcenſion* and *Declination.*

Example.

The Longitude of *Caſtor* is 15 deg. 33 min. of *Cancer*, and his Latitude 10 deg. 02 min. North; to find his *Right Aſcenſion* and *Declination.*

In the Oblique Triangle DIP, there is given the two Sides, IP 23 deg. 30 min. the Diſtance between the *Pole* of the *Equinoctial* and the *Pole* of the *Ecliptick*; ID 79 deg. 58 min. the Complement of the Latitude; and the contained Angle DIP 15 deg. 33 min. the Longitude from *Cancer*: To find one of the oppoſite Angles DPI, the Complement to 180 deg. of the *Right Aſcenſion* from *Cancer*; and the third Side DP, the Complement of Declination.

Plate 4. Fig. 20.

The Operation.

For the Right-Aſcenſion.

ID	79° 58′			
IP	23 30			
Sum	103 28	½ Sum	51° 44′ }	DIP 15° 33′
Diff.	58 28	½ Rem.	28 14 }	½ DIP 7 46

		Co. Ar.
As ſ. ½ Z cr^{a}. ID and IP	51° 44′	0.10505
To ſ. ½ X cr^{a}.	28 14	9.67492
So is tc. ½ DIP	07 46	10.86521
To t. ½ X *VV* DPI and IDP	77 14	10.64518

		Co. Ar.
As ſc. $\frac{1}{2}$ Z cr^{a}. I D and I P	51° 44′	0.20808
To ſc. $\frac{1}{2}$ X cr^{a}.	28 14	9.94499
So is tc. $\frac{1}{2}$ D I P	07 46	10.86521
To t. $\frac{1}{2}$ Z *VV* D P I and I D P	84 31	11.01828

$\frac{1}{2}$ Z *VV* 84° 31′
$\frac{1}{2}$ Z *VV* 77 14

Sum 161 45 D P I.

Whoſe Compl. to 180 deg. is 18 deg. 15 min. the *Right Aſcenſion* from *Cancer*; the *Right Aſcenſion* of *Cancer* is 90 deg. and therefore the *Right Aſcenſion* from *Aries* is 108 deg. 15 min.

For the Declination.

			Co. Ar.
As ſ. D P I	161° 45′	the Compl. of the Right Aſcen.	0.50423
To ſ. D I	79 58	the Compl. of Latitude	9.99331
So is ſ. D I P	15 33	the Longitude from *Cancer*	9.42826
To ſ. D P	57 28	the Compl. of the Declination	19.92580

Whoſe Compl. 32° 32′ is the Declination Northerly.

Problem XIX.

The Right Aſcenſion and Declination of a fixed Star being given, to find the Longitude and Latitude thereof.

Example.

The Right Aſcenſion of *Caſtor* is 108° 15′, and his Declination 32° 32′ North; to find his Longitude and Latitude.

In the Triangle I D P, there is given the two Sides, I P 23 deg. 30 min. P D 57 deg. 28 min. and the contained Angle D P I, 161 deg. 45 min. to find the oppoſite Angle D I P, and the third Side D I.

Fig. 20.

The

The Operation.

To find the Longitude.

PD 57° 28′
IP 23 30

Sum 80 58 $\frac{1}{2}$ Sum 40° 29′ { DPI 161° 45′
Diff. 33 58 $\frac{1}{2}$ Diff. 16 59 } $\frac{1}{2}$ DPI 80 52.

Co. Ar.
As ſ. $\frac{1}{2}$ Z cr^{a}. P D and IP ———— 40° 29′ ———— 0.18760
To ſ. $\frac{1}{2}$ X cr^{a}. ———— 16 59 ———— 9.46552
So is tc. $\frac{1}{2}$ D P I ———— 80 52 ———— 9.20621

To t. $\frac{1}{2}$ X *VV* D I P and I P D 04 08 ———— ~~1~~8.85933

Co. Ar.
As ſc. $\frac{1}{2}$ Z cr^{a}. P D and I P ———— 40° 29′ ———— 0.11885
To ſc. $\frac{1}{2}$ X cr^{a}. ———— 16 59 ———— 9.98063
So is tc. $\frac{1}{2}$ DP I ———— 80 52 ———— 9.20621

To t. $\frac{1}{2}$ Z *VV* D I P and I D P 11 25 ———— ~~1~~9.30569

$\frac{1}{2}$ Z *VV* 11° 25′
$\frac{1}{2}$ X *VV* 04 08

Sum 15 33 D I P the Longitude from *Cancer*.

To find the Latitude.

Co. Ar.
As ſ. D I P ———— 15° 33′ the Longitude from *Cancer*, 0.57174
To ſ. D P ———— 57 28 the Compl. of Declination, 9.92587
So is ſ. D P I 161 45 the Compl. of the Right Aſcen 9.49577

To ſ. DI ———— 80 01 the Compl. of the Latitude ~~1~~9.99338.

Problem

Plate III

Fig 16

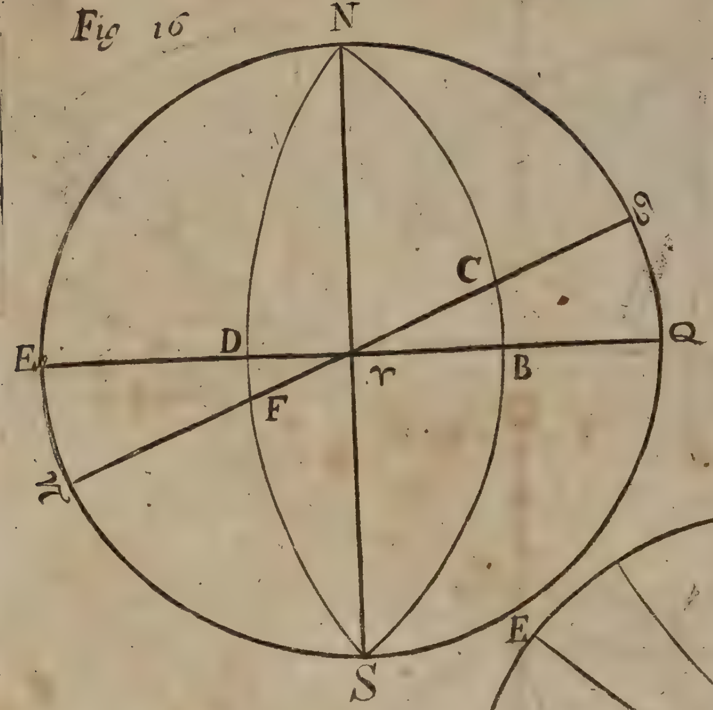


Fig 15

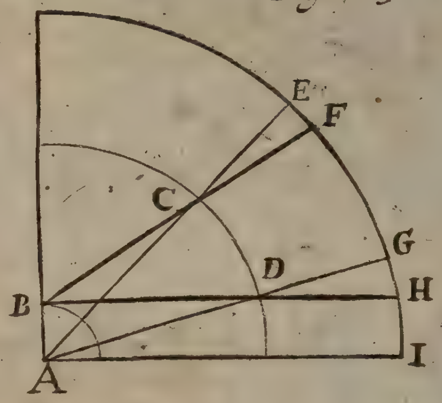


Fig 17

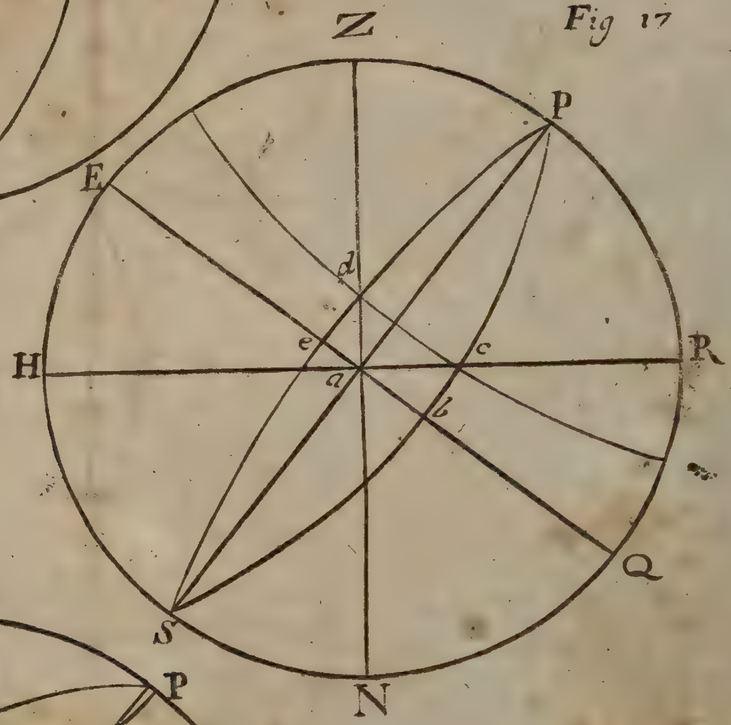
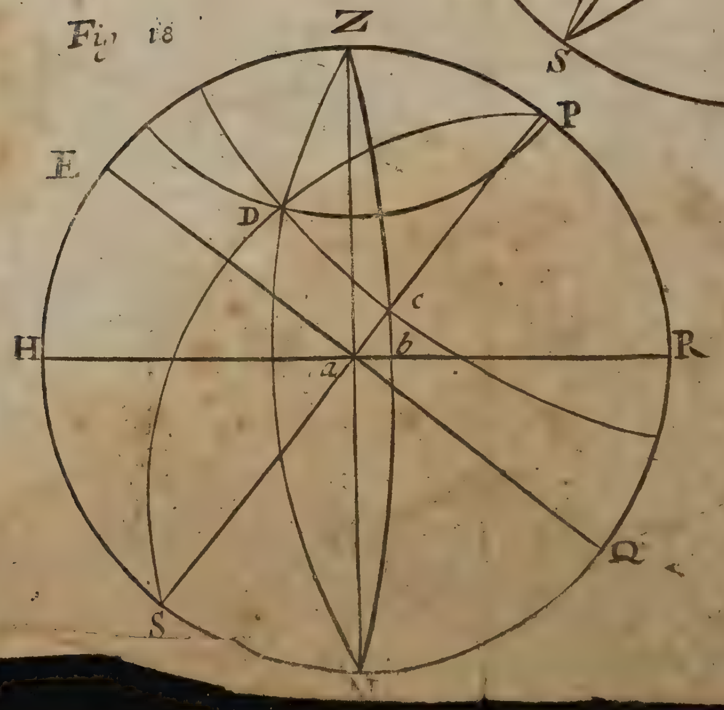


Fig 18



Problem XX.

The Diſtance of a *Planet*, *Comet*, or *New-Star*, from two known fixed Stars being given, to find the unknown Star's Longitude and Latitude.

Example.

The unknown Star's Diſtance from the *Swan's Beak* is 49 deg. 05 min. and from *Perſeus*'s *Side* 88 deg. 57 min. to find the Longitude and Latitude thereof.

Long.	Of the *Swan's Beak*,	♑	26°	39′	Lat.	49° 02′ N.
	Of *Perſeus*'s Side,	♉	27	12		30 05 N.

1. In the Triangle A D I, there is given two Sides, A I 40° 58′ the Compl. Lat. of the *Swan's Beak*, D I 59° 55′, the Compl. Lat. of *Perſeus*'s *Side*, the contained Angle A I D 120° 33′, the Difference of Longitude between the two Stars; and the Angle D A I, and the Side A D required.

Plate 4. Fig. 21.

The Operation.

			Co. Ar.
As ſ. ½ Z cr². A I and D I	50°	26′	0.11301
To ſ. ½ X cr².	09	28	9.21610
So is tc. ½ A I D	60	16	9.75676
To t. ½ X *VV* D A I and A D I	06	56	~~1~~9.08587

			Co. Ar.
As ſc. ½ Z cr². A I and D I	50°	26′	0.19588
To ſc. ½ X cr².	09	28	9.99404
So is tc. ½ A I D	60	16	9.75676
To t. ½ Z *VV* D A I and A D I	41	29	~~1~~9.94668

The Angle D A I is 48° 25′

			Co. Ar.
As ſ. D A I	48°	25′	0.12610
To ſ. D I	59	55	9.93716
So is ſ. A I D	120	33	9.93510
To ſ. A D	85	02	~~1~~9.99836

2. In the Triangle A D B, there is given the three Sides, A D 85°, 02′, the Diſtance between the two known Stars, A B 49° 05′, the unknown Star's Diſtance from the *Swan's-Beak*, B D 88° 57′, the Diſtance from *Perſeus*'s *Side*; and the Angle D A B required.

Plate 4. Fig. 21.

The Operation.

A D	85° 02′	Sine		Co. Ar.	0.00163
A B	49 05	Sine		Co. Ar.	0.12167
B D	88 57	½ Sum	111° 32′	Sine	9.96858
Sum	223 04	Rem.	22 35	Sine	9.58436
½ Sum	111 32			Sum	~~1~~9.67624
Rem.	22 35	Sc.	46 28	½ Sum	9.83812

Which being doubled, makes 92° 56′, the Angle D A B required.

Which being added to the Angle D A I, the Sum is B A I 141° 21′.

3. In the Triangle A B I, there is given the two Sides, A I 40° 58′, A B 49° 05′, the contained Angle B A I, 141° 21′, and the Angle A I B, the Difference of Longitude between the unknown Star, and the *Swan's Beak*; and the Side B I, the Compl. of the unknown Star's Latitude, required.

Plate 4. Fig. 21.

The Operation.

			Co. Ar.
As ſ. ½ Z cr^{a}. A I and A B	45°	01′	0.15039
To ſ. ½ X cr^{a}.	04	03	8.84897
So is tc. ½ B A I	70	40	9.54512
To t. ½ X *VV* A B I and A I B	02	00	~~1~~8.54448

As

			Co. Ar.
As ſc. $\frac{1}{2}$ Z cr^{a}. A I and A B	45°	01′	0.15064
To ſc. $\frac{1}{2}$ X cr^{a}.	04	03	9.99891
So is tc. $\frac{1}{2}$ B A I	70	40	9.54512
To t. $\frac{1}{2}$ Z *VV* A B I and A I B	26	20	~~1~~9.69467

The Angle A I B is 28° 20′, which added to the Longitude of the *Swan's Beak*, ♑ 26° 39′, makes the unknown Star's Longitude to be ♒ 24° 59′.

			Co. Ar.
As ſ. A I B	28°	20′	0.32367
To ſ. A B	49	05	9.87833
So is ſ. B A I	141	21	9.79557
To ſ. B I	83	57	~~1~~9.99757

Whoſe Compl. to 90°, that is 6° 03′, is the unknown Star's Latitude Northerly.

Problem XXI.

The *Meridian Altitude* of an unknown Star or Planet, and the Diſtance from a known fixed Star being given; to find the unknown Star's Latitude and Longitude.

Example.

In the Latitude 51° 32′ North, the Meridian Altitude of an unknown Star is 30° 36′, and his Diſtance from the Star in *Cepheus*'s Girdle is 84° 32′; to find his Longitude and Latitude.

The Meridian Altitude of the Star being given, his Declination is alſo given.

For the Meridian Altitude ſubtracted from the Complement of the Latitude 38 deg. 28 min. there remains 7 deg. 52 min. the Declination South.

Firſt, Therefore in the Triangle A O P, there is given the three Sides, O P 20 deg. 52 min. the known Star's Diſtance from the *North*

Pole, A P 97 deg. 52 min. the unknown Star's Diſtance therefrom; A O 84 deg. 32 min. the Diſtance between the two Stars, and the Angle A P O required, being the Difference of *Right-Aſcenſion* between the two Stars.

Plate 5. *Fig*. 22.

The Operation.

O P	20° 52′	Sine	Co. Ar.	0.44831
A P	97 52	Sine	Co. Ar.	0.00411
½ Sum	101 38	Sine		9.99098
Rem.	17 06	Sine		9.46841
			Sum	19.91181
Sc.	25 23		½ Sum	9.95590

Which doubled is 50 deg. 46 min. the Angle A P O.

The Right Aſcenſion of *Cepheus*'s *Girdle* is 321 deg. 02 min. to which adding 50 deg. 46 min. (the unknown Star being to the Eaſtward of the known Star) produceth the Right-Aſcenſion of the unknown Star 11 deg. 48 min.

Secondly, Then having the unknown Star's Right-Aſcenſion and Declination, you may find his Longitude and Latitude by *Problem* 19.

Problem XXII.

Having the Latitude of the Place, the Sun's Right-Aſcenſion, and the Altitude of a known fixed Star; to find the Hour of the Night.

Example.

In the Latitude 51 deg. 32 min. the Sun's Right-Aſcenſion being 228 deg. 45 min. and the Altitude of *Aldebran* 38 deg. 58 min. to the Eaſtward of the Meridian; to find the Hour of the Night.

The Right Aſcenſion of *Aldebran* is 64 deg. 10 min. and his Declination 15 deg. 46 min.

In the Triangle A P Z, there is given the three Sides, P Z 38° 28′, the Compl. of the Latitude; A Z 51 deg. 02 min. the Compl. of the Star's Altitude; A P 74 deg. 14 min. the Compl. of his

Decli-

Plate IIII.

Fig 19

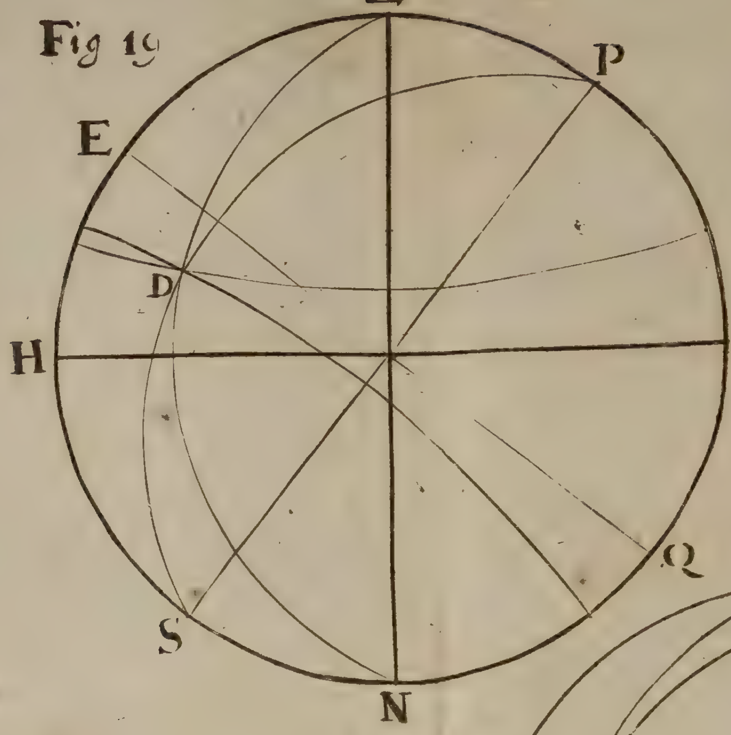
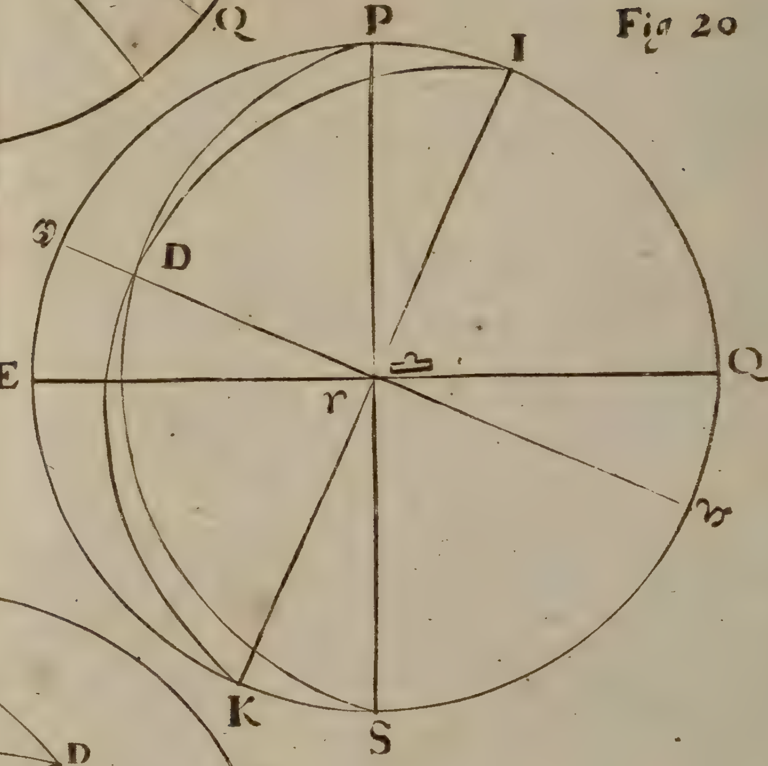


Fig 20



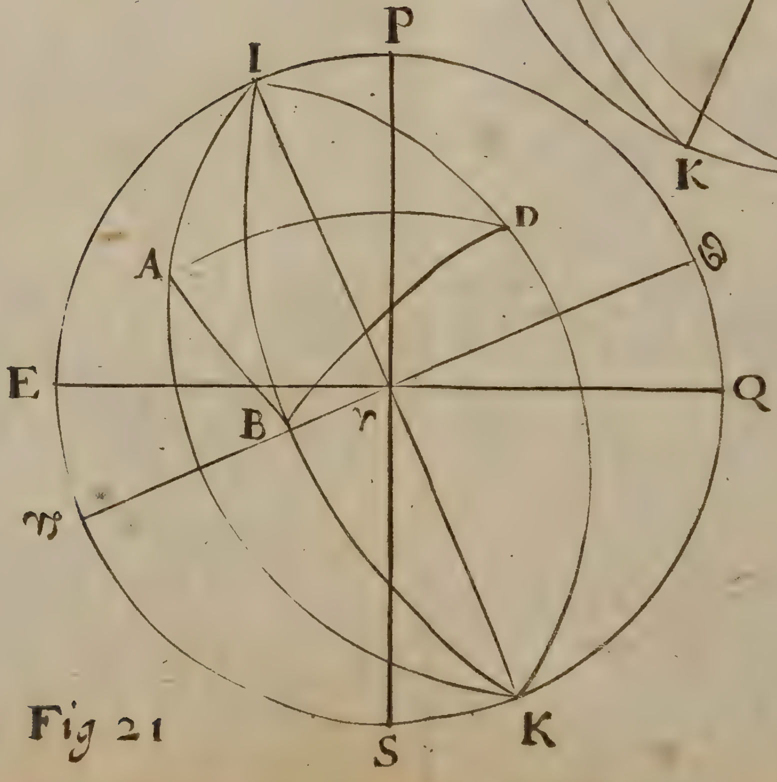


Fig 21

Pag: 120

Declination; to find the Angle A P Z, the Difference of Right Aſcenſion between the *Medium Cœli* and *Aldebran.*

Plate 5. *Fig.* 23.

The Operation.

A P	Sine	74° 14′	Co. Ar.	0.01666
P Z	Sine	38 28	Co. Ar.	0.20617
½ Sum,	Sine	81 52		9.99561
Rem.	Sine	30 50		9.70973
			Sum,	19.92817
	Sc.	22 59	½ Sum,	9.96408

Which doubled, produces 45 deg. 58 min.

This ſubtracted from the Right Aſcenſion of *Aldebran,* leaves 18° 12′, the Right Aſcenſion of the *Mid-Heaven.* Add 360 deg. to 18 deg. 12 min. and from the Sum ſubtract the Sun's Right-Aſcen. 228 deg. 45 min. the Remainder 149 deg. 27 min. reduced into Time, makes 9 hours 57 min. 48 ſeconds, the Hour of the Night ſought.

Problem XXIII.

Two unequal Altitudes of the Sun taken in one Day, with the Time between the Obſervations, and the Sun's Declination being given; to find the Latitude of the Place of Obſervation.

Example.

The two Altitudes are 43 deg. 06 min. and 56 deg. 34 min. the Time between the Obſervations is 2 hours, and the Sun's Declination 20° 14′ North; to find the Latitude of the Place Northerly.

In the Right-angled Triangle A B P, there is given the *Hypotenuſe* A P 69° 46′, the Complement of the Declination, the Angle A P B 15°, half the Time between the Obſervations, and the oppoſite Leg A B required.

Plate 5. *Fig.* 24.

The Operation.

As Radius		Log.	10.00000
To ſ. A P B	15° 00′		9.41300
So is ſ. A P	69 46		9.97234
To ſ. A B	14 03		19.38534

Which being doubled, gives A E 28 deg. 06 min.

Secondly; In the Oblique-angled Triangle A P E, there is given the two Sides A E 28 deg. 06 min. E P 69 deg. 46 min. the oppoſite Angle A P E 30 deg. 00 min. and the other oppoſite Angle E A P required.

Plate 5. *Fig*. 24.

The Operation.

		Co. Ar.
As ſ. A E	28° 06′	0.32697
To ſ. A P E	30 00	9.69897
So is ſ. E P	69 46	9.97234
To ſ. E A P	84 54	19.99828

Thirdly; In the Oblique-angled Triang A Z E, there is given the three Sides, A Z 33 deg. 26 min. the Compl. of the greater Altitude, E Z 46 deg. 54 min. the Compl. of the leſſer, A E 28 deg. 06 min. and the Angle E A Z required.

Plate 5. *Fig*. 24.

The Operation.

A Z	Sine	33° 26′	Co. Ar.	0.25888
A E	Sine	28 06	Co. Ar.	0.32697
½ Sum,	Sine	54 13	Log.	9.90915
Rem.	Sine	05 19		9.10501
			Sum,	19.60001
Sc.		50 52	½ Sum,	9.80000

Which doubled, produces E A Z 101° 44′; from which ſubtracting E A P 84° 54′, there remains P A Z 16° 50′.

Fourthly; In the Oblique-angled Triangle A P Z, there is given the two Sides A P 69 deg. 46 min. A Z 33 deg. 26 min. the contained Angle P A Z 16° 50′; and the third Side P Z required.

Plate 5. *Fig.* 24.

The Operation.

As Radius			10.00000
To ſc. P A Z	16°	50′	9.98098
So is t. A Z	33	26	9.81968
To t. of a fourth Arch	32	17	19.80066
			Co. Ar.
As ſc. of the *4th* Arch	32°	17′	0.07293
To ſc. of the Reſidual	37	29	9.89956
So is ſc. A Z	33	26	9.92144
To ſc. P Z	38	26	19.89393
Whoſe Compl.	51	34 is the Latitude Northerly.	

Problem XXIV.

Two unequal Altitudes of the Sun, and the Difference of their Correſpondent *Azimuths* taken in one Day, and the Sun's Declination being given; to find the Latitude of the Place of Obſervation.

Example.

The firſt Altitude is 43 deg. 6 min. and the ſecond Altitude 56 deg. 34 min. the Difference of *Azimuths* 39 deg. 16 min. and the Sun's Declination is 20 deg. 14 min. North; To find the Latitude of the Place Northerly.

Firſt; In the Oblique-angled Triangle A E Z, there is given the two Sides A Z 33° 26′, E Z 46° 54′, the contained Angle A Z E 39° 16′, the Difference of the *Azimuths*; and the Angle E A Z, and the third Side A E required.

Plate 5. *Fig.* 24.

The Operation.

			Co. Ar.
As ſ. $\frac{1}{2}$ Z cr^{s}. A Z and E Z	40°	10′	0.19043
To ſ. $\frac{1}{2}$ X cr^{s}.	06	44	9.06911
So is tc. $\frac{1}{2}$ A Z E	19	38	10.44765
To t. $\frac{1}{2}$ X VV E A Z and A E Z	27	00	19.70719

			Co. Ar.
As ſc. $\frac{1}{2}$ Z cr^{s}. A Z and E Z	40°	10′	011681
To ſc. $\frac{1}{2}$ X cr^{s}.	06	44	9.99699
So is tc. $\frac{1}{2}$ A Z E	19	38	10.44765
To t. $\frac{1}{2}$ Z VV E A Z and A E Z	74	39	10.56145

The Angle E A Z is 101° 39′.

			Co. Ar.
As ſ. E A Z	101°	39′	0.00904
To ſ. E Z	46	54	9.86342
So is ſ. A Z E	39	16	9.80136
To ſ. A E	28	09	19.67382

Secondly; In the Right-angled Triangle A B P, there is given the *Hypotenuſe* A P 69 deg. 46 min. the Leg A B 14 deg. 04 min. the half of A E, and the adjacent Angle B A P required.

Plate 5. *Fig*. 24.

The Operation.

As Radius	10.00000
To tc. A P 69° 46′	9.56654
So is t. A B 14 04	9.39892
To ſc. B A P 84 42	18.96546

From the Angle E A Z 101 deg. 39 min. ſubtract the Angle E A P 84 deg. 42 min. there remains the Angle P A Z 16 deg. 57 min.

Thirdly; In the Oblique-angled Triangle P A Z, there is given the two Sides A P 69° 46′, A Z 33° 26′, the contained Angle P A Z 16° 57′, and the third Side P Z required.

Plate 5. *Fig*. 24.

The

Fig 22

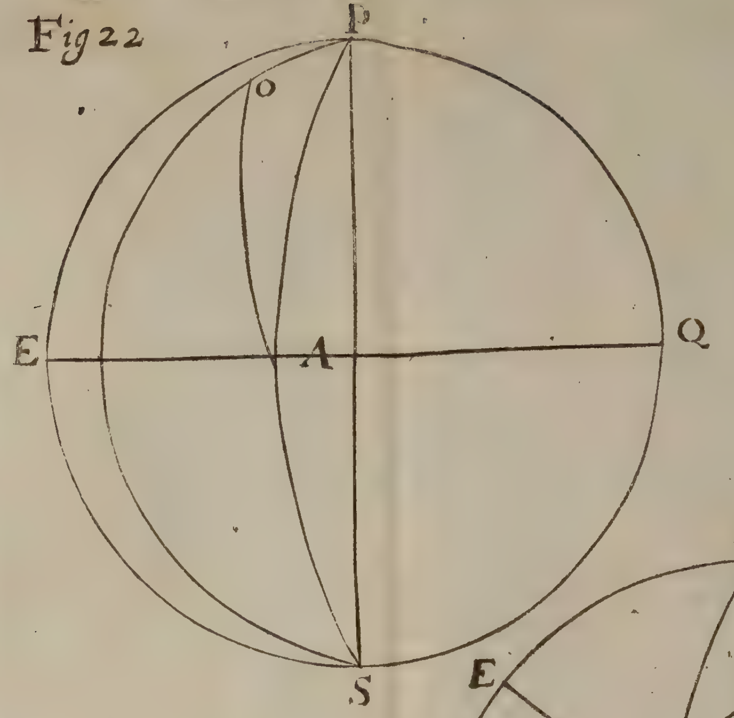


Fig 23

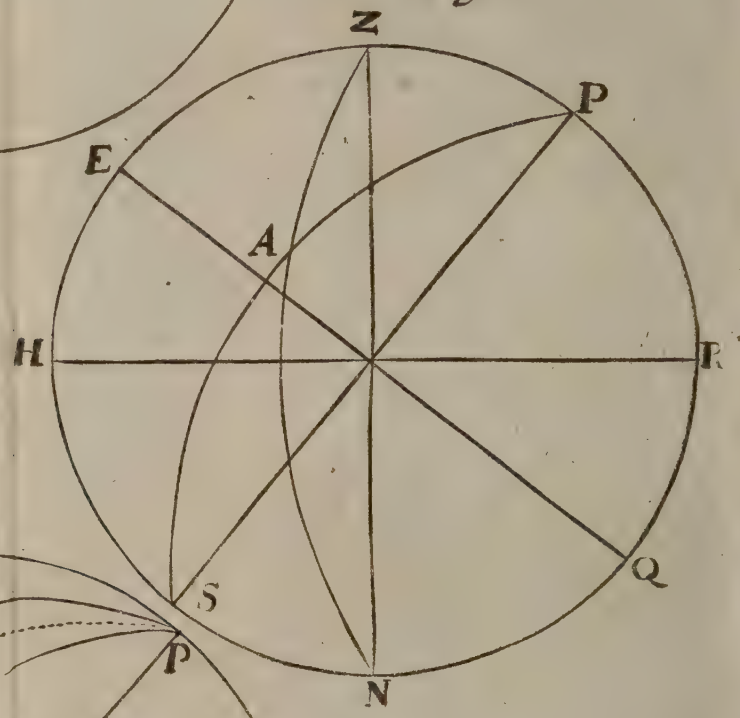
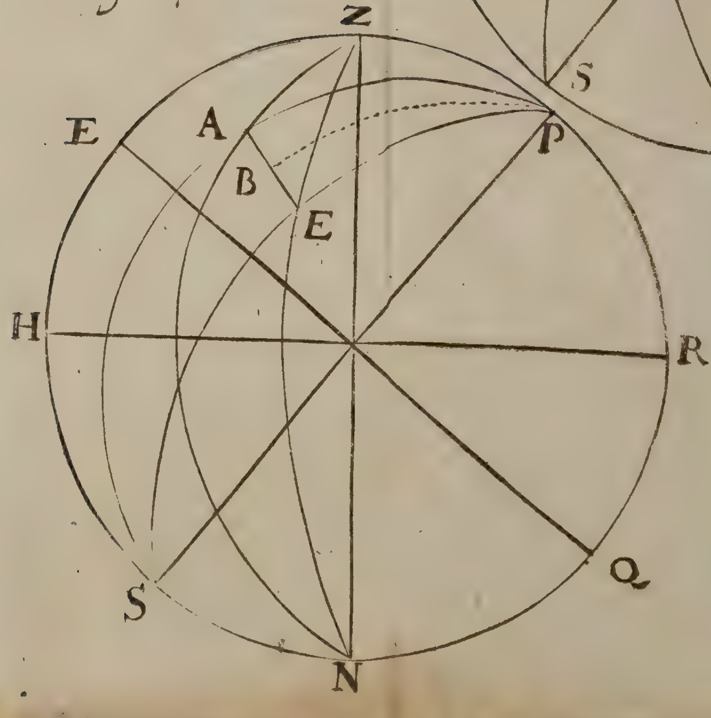


Fig 24



The Operation.

As Radius		Log.	10.00000
To ſc. P A Z	16°	57′	9.98071
So is t. A Z	33	26	9.81968
To t. of a fourth Arch	32	16	19.80039
			Co. Ar.
As ſc. of the fourth Arch	32°	16′	0.07285
To ſc. of the Reſidual	37	30	9.89947
So is ſc. A Z	33	26	9.92144
To ſc. P Z	38	28	19.89376

Whoſe Compl. 51 32 is the Latitude North.

S E C T. III.

Containing the general Aſtronomical Theories.

The Ptolomaick Syſtem.

THE *Ptolomaick Syſtem* is that which was by *Ptolomy* invented, and ſuppoſeth the Earth to be fixed as the Center of the World, and that all the Celeſtial Bodies move round the ſame in their Diurnal and Annual Revolutions.

The World is ſuppoſed to be divided principally into two Parts, Elementary and Celeſtial.

The Elementary admits of four Diviſions.

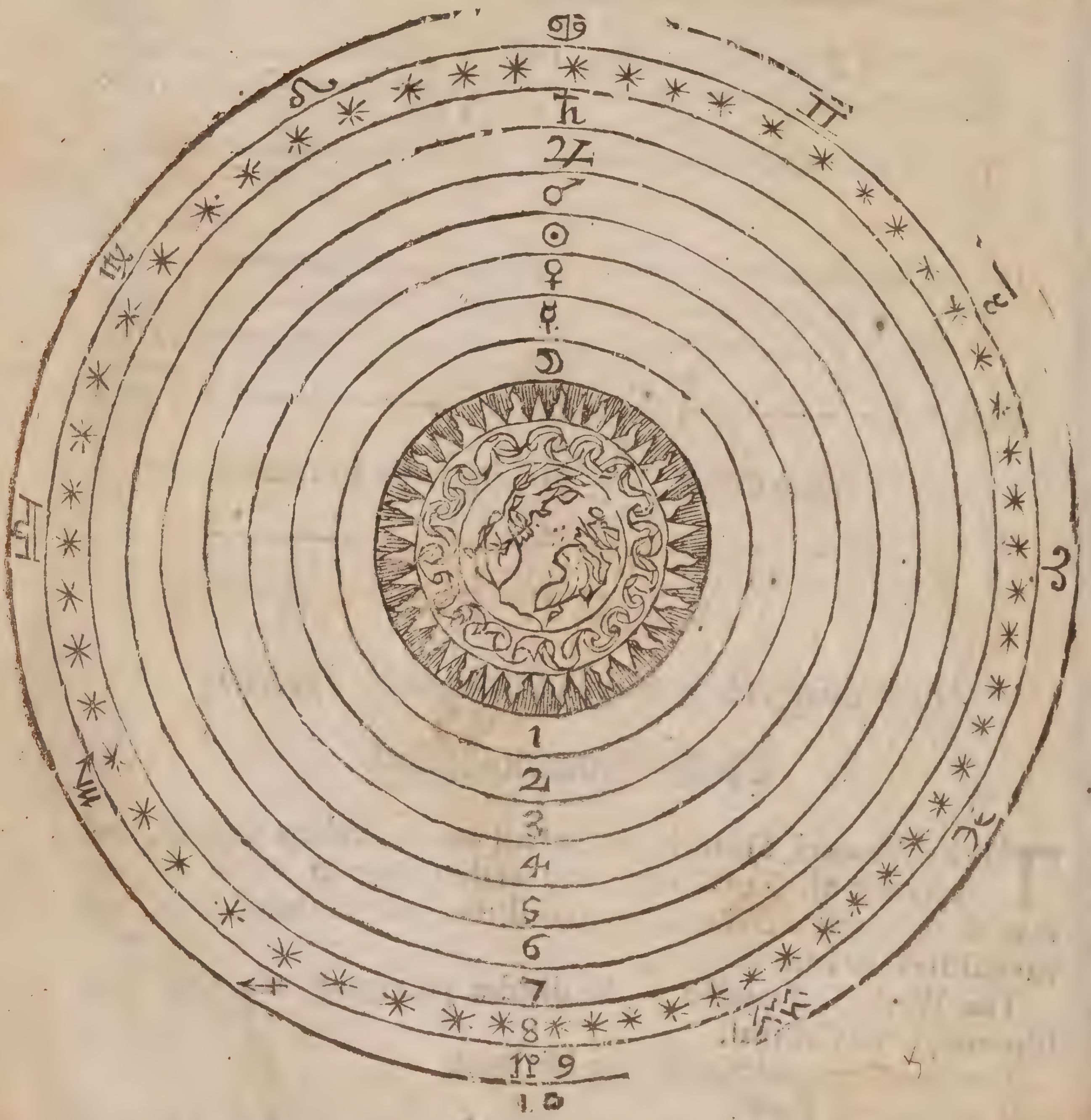
The firſt is the *Earth.*

The ſecond is the *Water*; both which make one intire Body or Globe, whereon we dwell.

The third is the *Air*, encompaſſing the *Earth.*

And the fourth is *Fire*, which according to the Opinion of antient Philoſophers, is contained in that ſpace between the *Air* and the Sphere of the Moon; as you may ſee in the following Figure.

The Figure of the Ptolomaick Syſtem.



These four Elements are ſubject to a continual Change and Alteration one into another, according to the Proverb,

Omnia Sublunaria mutabilia.

The Celeſtial Part is that which is without theſe Elementary Parts, void of all Changes, and is by the antient *Aſtronomers* divided into ten Parts or Heavens.

The firſt of which, next to the Region of Fire, is the Heaven or Orb of the *Moon.*

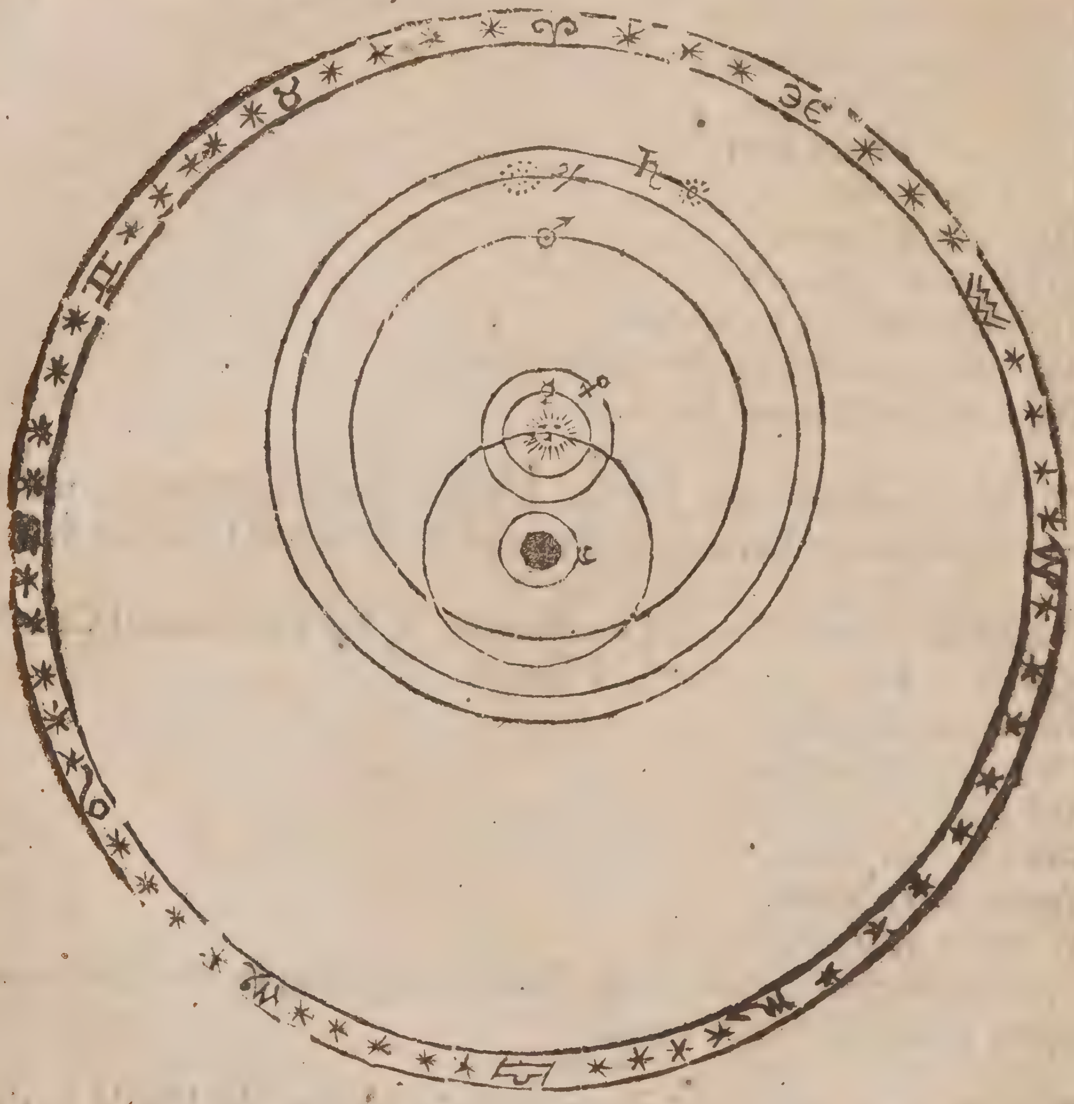
The ſecond of *Mercury.*
The third of *Venus.*
The fourth of the *Sun.*
The fifth of *Mars.*
The ſixth of *Jupiter.*
The ſeventh of *Saturn.*
The eighth of the *Fixed Stars.*
The ninth is called the *Chriſtaline Heaven:*
The tenth the *Primum Mobile.*

The Magnitude of theſe Heavens is known by their Courſes, which thoſe great Bodies within them make round the Poles of the *Zodiack.*

The *Moon* runneth through the Heavens, by her own natural Courſe, from *Weſt* to *Eaſt*, in 27 Days, 8 Hours.
Mercury in 88 Days.
Venus in 225 Days.
And the *Sun* in a Year.
Mars in two Years,
Jupiter in 12 Years.
Saturn in 30 Years.
The *Eighth Heaven* perfects its Courſe, according to the Affirmation of *Tycho Brahe*, in 25400 Years.

Theſe Heavens are turned about upon the *Axis* of the World by the tenth Heaven, which is the *Primum Mobile*, or *Firſt Mover*; by which Motion is cauſed Day and Night, and the daily riſing and ſetting of the Heavenly Lights.

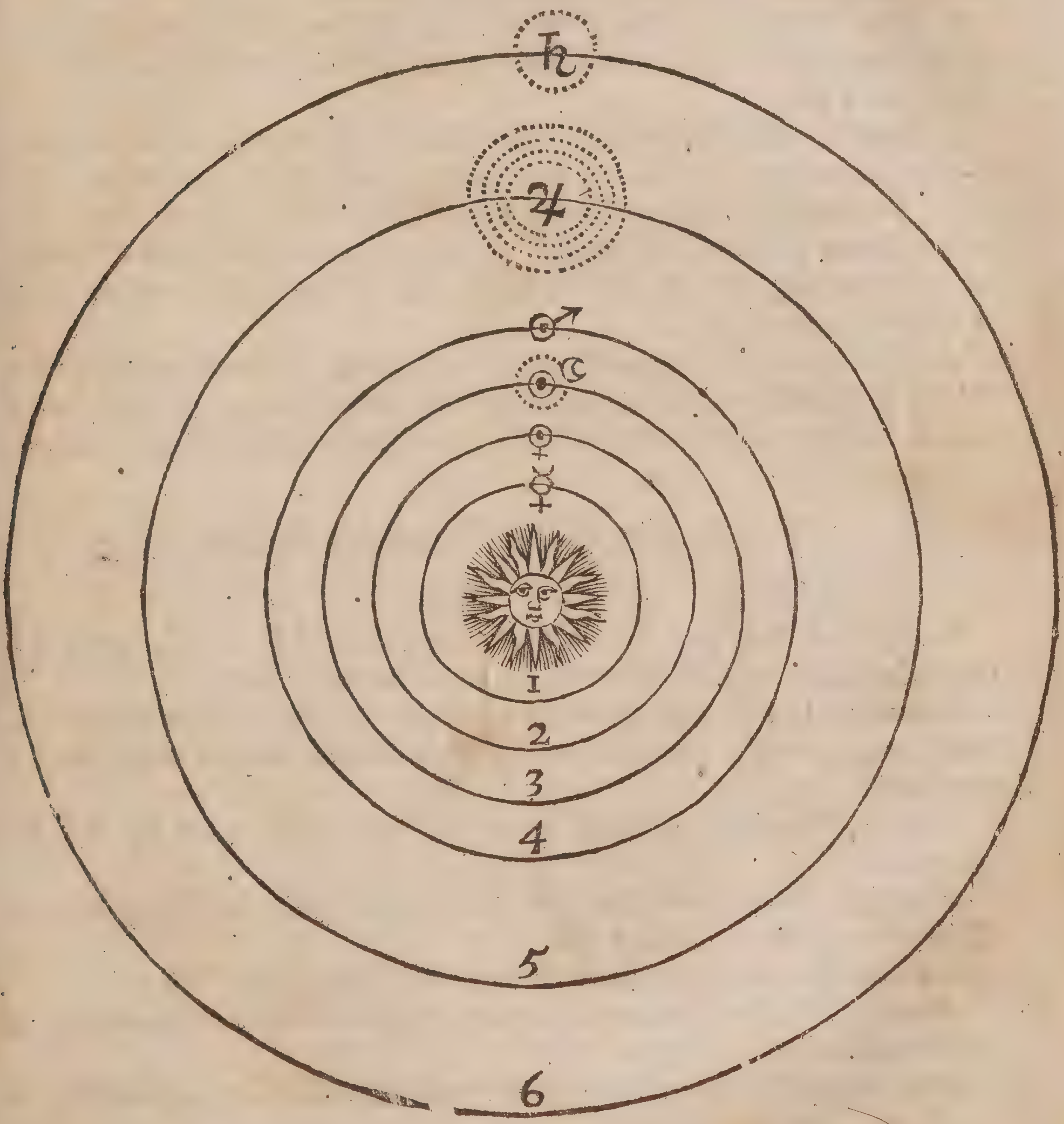
The Tychonean Syſtem.



This *Hypotheſis* derives its Name from the Author thereof, *Tycho Brahe*, a Nobleman of *Denmark*, the moſt famous *Aſtronomical* Obſervator in the World in his Days, who by his own Obſervations did rectify the Places of moſt of the *Fixed Stars*, which appeared in that *Horizon* wherein he lived. This famous Man, according to his preſent Apprehenſion, framed this *Hypotheſis* of the Heavenly Motions, wherein he ſuppoſeth, that *Venus*, *Mercury*, *Mars*, *Jupiter*, *Saturn* in their Motion, reſpect the *Sun* as their Center; and the *Sun* and *Moon* the *Earth*; and that *Saturn*, in Oppoſition to the *Sun*, is nearer to the *Earth* than

Venus in *Apogeon*; and that *Mars* in Oppoſition is nearer the *Earth* than the *Sun* it ſelf; as may appear in the ſaid *Hypotheſis*.

The Copernican Syſtem.



This *Hypotheſis* was firſt invented by *Pythagoras*, and revived by *Copernicus*, a famous *Aſtronomer* of *Germany*, who lived in the Year 1500, who ſuppoſes,

1. That the Sun is placed in the midſt of the World, in or about the Center of the Sphere of the fixed Stars, and hath no Circular Motion, but Central only.

2. The primary Planets are each of them in their proper Syſtems moved about the Sun, and accompliſh their Periodical Revolutions moſt exactly in their determinate and appointed Times.

3. That the Earth is one of the Planets, and with her annual Motion about the Sun, deſcribeth her Orb in the middle between the Orbs of *Mars* and *Venus*.

4. That the ſecondary Planets are ordinarily moved about the primary Planets, reſpecting their Bodies for their common Nodes or Centers.

5. That the ſecondary Planet, the *Moon*, is moved about the Earth as her Center; where, by reaſon of the annual Motion of the Earth, ſhe hath not only Relation to the Earth, but by conſequence to the *Sun*, as have the other Planets.

6. That as this primary Planet, the Earth, is environed with the Sphere of the Moon; ſo are ſome of the other Primary Planets, who have in like manner their Moons or Concomitants encompaſſing them.

The Motion of the Planetary Syſtem.

Firſt, The *Sun* hath only a Rotation from *Weſt* or *Eaſt*, upon his own *Axis*, in the ſpace of twenty ſix days, or thereabouts.

Secondly, The Planet *Mercury* performs his Revolution about the Sun in eighty eight days; which is noted in the Scheme with the Figure 1 ☿.

Thirdly, The Revolution of *Venus* in 225 days, noted by the Figure 2 ♀.

Fourthly, The Revolution of the *Earth* with the Moon in one Year; noted by the Circle 3 ⊙.

Fifthly, The Revolution of *Mars* in two Years; noted by 4 ♂.

Sixthly, The Revolution of *Jupiter*, with his four Companions, in 12 Years; noted with 5 ♃.

Seventhly, The Revolution of *Saturn*, with his Ring and Moon, in 30 Years; noted by 6 ♄.

The *Moon* circumvolveth the Earth every Month; *Jupiter*'s four Attendants him, in time correſponding their Diſtances from him.

The firſt and next him, in one day 18 hours.

The ſecond next without that, in 3 days 13 hours.

The third in 7 days 4 hours.

And the fourth and outmoſt, in 16 days 8 hours.

Saturn's Moon moves about him in 16 days; and all from *Weſt* to *Eaſt*, according to their Revolutions about the Sun.

Saturn, *Jupiter*, *Mars*, the *Earth*, *Venus*, and *Mercury* (whoſe Revolutions reſpect the *Sun* only) are called *Primary Planets.*

The reſt (that move again) about *Saturn*, *Jupiter*, and the *Earth*, *Secondary Planets.*

The *Earth* hath a Revolution upon her *Equinoctial* Poles in 24 hours, from *Weſt* to *Eaſt.*

The *Secondary Planets* are all of them much leſs in Magnitude than their *Primary*; and all the *Planets* together much leſs than the *Sun*, from whom they all receive their Light, Virtue, and principal Power of Motion.

Far without the *Planetary Syſtem* are placed all the *Fixed Stars*, in ſeveral Diſtances; but all unto us incommenſurable: The *Parallax* of the *Earth*'s Orb being inſenſible in any of their Places.

A Deſcription of the Golden Number, Cycle *of the* Sun, Roman Indiction, Epact, *and* Leap Year.

THE *Golden Number*, or *Prime*, is a Circular Revolution of 19 Years, in which Term of Years it hath been antiently ſuppoſed, that the *Sun* and *Moon* do make all the variety of Aſpects one to another.

The *Cycle* of the *Sun* maketh its Revolution in 28 Years, becauſe in that time all the Variety of the *Dominical Letters* and *Leap-Years* are expired, and the 29*th* Year the Cycle doth begin again; which Number is to find out the *Dominical Letter* for any Year paſt, preſent, or to come.

The *Roman Indiction* conſiſteth of 15 Years, and is ſet down in the Charters and Writings of the *Protonotaries* of the Pope of *Rome*; for once in 15 Years the Nations were to pay Tribute to the *Romans*.

The *Epact* is a Number never exceeding 30 days; it is the 11 days and ſix hours, which added to the *Lunar Year*, being 354 days, do make it equal to the *Solar Year*, which is 365 days.

The *Leap Year* is every fourth Year, which hath one Day more in it than a common Year; this Day is made up in four Years, by the odd ſix hours that are over and above 365 Days, which Day is added after the 24*th* of *February:* ſo that in the Leap-Year *February* hath twenty nine Days. And here note, that the *Prime* and *Dominical Letter*, and the *Cycle of the Sun*, change the firſt of *January*; and the *Epact* the firſt of *March*; and the *Roman Indiction* the firſt of *September*.

Memorial Verſes on the Eccleſiaſtical and Civil Kalendar, &c. By Mr. T. S.

To know if it be Leap-Year.

Divide the Year by 4; *What's left ſhall be,*
For Leap Year 0, *for paſt*, 1, 2, *or* 3.

Here you may omit the Hundreds of the Year of our Lord, and divide the Reſidue by 4.

For Example.

Anno 1695, omitting the Hundreds, I divide the Reſidue, which is 95, by 4, and there remains 3, which ſhews it is the 3*d* after *Leap-Year.*

To find the Dominical Letter.

Divide the Year its 4th, *and* 4 *by* 7;
What's left, ſubtract from 7; *the Letter's given,*
A 1. B 2. C 3. D 4. E 5. F 6. G 7.

Example.

Of the Year of Chriſt	1695
The 4*th* part (omitting Fraction) is	423
To both which I add the Number	4
The Sum is	2122

Which divided by 7, there is left 1; which ſubtracted from 7, there reſts 6; which ſhews that the Dominical Letter for the Year *1695*, is the *6th* in order of the Alphabet, that is F.

But the Leap-Year hath two Dominical Letters; the latter found by this Rule, ſerveth from St. *Matthias*'s Day to the Year's end; and for finding *Eaſter*, the former (next following in order from A to G, and beginning again at A) ſerveth from *New-Years-Day* unto St. *Matthias.*

For the Golden Number, Cycle of the Sun, and Indiction.

When 1, 9, 3, *to th'Year hath added been,*
Divide by 19, 28, 15.

Example.

To 1695 I add 1, the Sum *1696* I divide by 19, and there remains 5, which is the Golden Number for the Year *1695*.

Again, to *1695* I add 9, and the Sum 1704 I divide by 28, the Reſidue 24 is the Cycle of the Sun *Anno* 1695.

Laſtly, to 1695 I add 3, the Sum 1698 divided by 15, the Remainder 3, which ſhews it is the third Year of the Indiction for the Year 1695.

The Prime or Golden Number being given, to find the Epact.

Divide by 3, *for each one left add* 10;
30 *reject: the Prime makes Epact then.*

Example.

Anno 1695, the Golden Number 5 I divide by 3, and there is left 2: therefore ten times 2, which is 20, added to 5, the Sum is 25, the Epact for the Year 1695.

By the nineteen Epacts, to find the Day of Eaſter-Limit, from the beginning of March *incluſively.*

The Epacts take from 47; *but two,*
The greateſt take from 77; *'twill do.*

Example.

Anno 1695, the Epact being 25, I ſubtract it from 47, and the Reſidue 22 is *Eaſter-Limit*, *Anno* 1695, that is, *March* 22, reckoned from the begining of *March* incluſively.

But when the Epact is 28 or 29, it muſt be ſubtracted from 77, that ſo the Limit may remain. And the next following Sunday after the Limit is always Eaſter-Day.

Eaſter Limit, and the Dominical Letter being given; To find Eaſter-Day.

The Letter more by 4 *from Limit take;*
What's left from neareſt Sevens, ſhall Eaſter make.

Or thus;

Take the Number of the given Letter more by 4 from the given Limit, and the Reſidue from the neareſt greater Sum of Sevens; the laſt Remainder added to the Limit; the Sum, or its exceſs above 31, is Eaſter-Day, in *March* or *April.*

Example.

Anno 1695, the Dominical Letter is F, which is the ſixth Letter in order, which more by 4 is 10, which taken from the Limit 22, the Reſidue is 12; this take from the neareſt greater Sum of Sevens, which is 14, and there remains 2, which being added to the Limit 22, the Sum 24, being the 24*th* of *March*, is Eaſter-Day 1695.

For

For the Days of the Months on which the Sun entreth the 12 Signs.

Twice 9, *twice* 10, *four* 12's, 11;
Then 10, *then* 9, *then* 8, *or* 7.

Anno 1700. ☉ *in*

♈.	♉.	♊.	♋.	♌.	♍.	♎.	♏.	♐.	♑.	♒.	♓.
Mar.	Apr.	May.	Jun.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
9.	9.	10.	10.	12.	12.	12.	12.	11.	10.	9.	8.

For the Degree of the Sun's Place on any Day.

From the Day of the Month on which the Sun's Place is required, if you may, or elſe from the Sum of that and 30, ſubtract the Day of his Entrance into the Sign of that Month, the Remainder ſhall be the degree of his Place in that or the next preceding Sign.

For the Age of the Moon, or Day of her Change.

Janus 0, 2, 1, 2, 3, 4, 5, 6;
8, 8, 10, 10, *theſe to the Epact fix:*
The Sum (bate 30) *to the Month-day add,*
Or take from 30; *Age or Change is had.*

Or thus; Add to the Epact in

Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
0.	2.	1.	2.	3.	4.	5.	6.	8.	8.	10.	10.

The Sum, if it be leſs than 30, or elſe the exceſs above 30, added to the Day of the given Month, (rejecting 30 if need be) gives the Age of the Moon that Day; but ſubtracted from 30, leaves the Day of the Change in or from the beginning of that Month.

For the Day of the Full Moon, add or ſubtract 15, to or from the Day of the Change.

Example.

1. For the Age of the Moon, *Anno* 1695. May 29, the Number for the Month 3, added to the Epact 25, makes 28; which added to 29, (rejecting 30 from the Sun) gives 27, the Age of the Moon required.

2. For the Day of the Change (or *New-Moon*) in *May* 1695, the Epact 25, with the Month 3, makes 28 (as afore;) which ſubtracted from 30, the Reſidue 2 is the Day of the New-Moon in *May* 1695.

3. To which if you add 15, makes 17, the day of Full-Moon in *May* 1695.

To find the Day of the New-Moon, and the Entrance of the Sun into the Signs, for Time paſt, or to come.

312, 131, ——— ——— ——— ———
Paſt, add; to come, ſubtract for Moon and Sun.

Or thus:

For every 312 Years paſt, add 1 Day to the Time of the *New-Moon*, found above; for 312 Years to come, ſubtract 1 Day.

Likewiſe for 131 Years paſt, a Day is to be added to the former account of the Sun's Entrance; and for 131 Years to come, ſubtracted.

To find the Diſtance of the Sun from the Nodes of the Moon perpetually in all Lunations; Remember,

Year 17 hundred, Node, Sign 4, Degree
27, 3, 800, 43.

1. Take the Interval between the given Time, and 1700 compleat in Years and Days, allowing 12 Months to the Year, and 30 Days to a Month; and the Account will ſuffice for this Work.

2. Multiply the Years of the Interval by 43, and divide the Product by 800, the Reſidue multiply by 9; then take the half of this Product, and diſtinguiſh the laſt Figure from the reſt by a Point: So

have you the Degrees, and 10*th* parts of a Degree, anſwerable to the Years of Interval. Alſo multiply the Days of the Interval by 43, and divide by 800; this Quotient ſhews the degrees, and the Remainder divided by 80, the 10*th* part of a degree of the Motion for the days of the Interval. Then collect the former and latter Degrees and Tenths into one Sum, and reduce it into Signs, Degrees, and Tenths.

3. For Time afore 1700 compleat, add the Signs, Degrees and Tenths thus found, to 4^s, 27°, 3 tenths : but for Time after 1700 compleat, ſubtract them from 4^s, 27°, 3 tenths, and the Sum or Remainder ſhall be for the Place of ☊, adding 1 degree for the tenths, if they exceed 5, elſe rejecting them.

Always in Additions omit Cycles (to wit, 12^s or 360°) but in Subtractions add one Cycle, if need be, to the Number from which you are to ſubtract.

Next by the common Rule for 1700, without any correction for time paſt or to come, find the Sign and Degree of the Sun's Place, and ſubtract the laſt found place of ☊ from it ; the Reſidue is the Diſtance of ☉ from ☊ required.

The Limits of Eclipſes of the Sun and Moon, in Degrees from ☊ *or* ☋.

Within 16 *the Sun, and* 10 *the Moon*
Suffer Eclipſe ; above 18, 12, *none.*

To find the Length of the Days and Nights in the Latitude 52 deg. *for ever.*

To 15, 1 ; 1, 16 ; 2, 6, 3 ;
1, 2, 3, 4 *hours* ; 4 *and half agree.*

To the given Diſtances of the Sun from the next Equinoctial Point, the anſwerable hours are theſe ; to 15°, 1 hour ; to 1 Sign, 2 hours ; to 1 Sign 16°, 3 hours ; to 2 Signs 6°, 4 hours ; and to 3 Signs 4 hours and a half ; which hours added to 12, the Sum is from the Vernal Equinox to the Autumnal, the juſt length of the Day ; but from the Autumnal to the Vernal, the length of the Night in thoſe diſtances.

And for all other intermediate Diſtances of ⊙ from the Equinoctial Points, the Proportion is, As 15, 16, or 20° to 60′; or as 20° to 30′: So are the Degrees of the Exceſs of the intermediate Diſtances above $0^{s}\,15^{\circ}$, $1^{s}\,16^{\circ}$, or $2^{s}\,6^{\circ}$, and not exceeding $2^{s}\,26^{\circ}$, to the Minutes of the length of the Day or Night, above 12, 13, 14, 15, or 16 hours. Always allowing 4 Degrees or Days afore and after the Ingreſs into ♋ and ♈, for Solſtice.

The Length of the Day and Night taken together is 24 hours, from which if the one be ſubtracted, there will remain the other; And,

Half the Length of the $\left\{\begin{array}{l}\text{Night,}\\ \text{Day,}\end{array}\right\}$ is the time of $\left\{\begin{array}{l}\text{Sun-riſing.}\\ \text{Sun-ſetting.}\end{array}\right.$

To find the Hour of the Moon's coming to South, and High-Water at London.

The Moon's Age multip'y by 4; *Divide*
By 5 *for Southing*; *add* 3 *for the Tide.*

But when the Age of the Moon exceeds 15 days, you may reject 15; As in this Example.

Anno 1695, the Moon being 27 days old, out of which reject 15, the Remainder is 12, which being multiplied by 4 makes 48, which divided by 5, the Quotient is 9, and 3 in the Remainder: which ſhews that the Moon cometh to South at 9 of the Clock, and three times 12 minutes paſt, which is 36 minutes, (and here note, that for every Unit in the Remainder, you muſt reckon ſo many times 12′, which muſt be added to the hour found in the Quotient, as in the Example aforegoing:) to which I add 3 hours, and the Sum is 12 hours 36 min. the time of full-Sea at *London.*

But it is here to be noted, that by manifeſt Experience it is found, that when the Moon is in either of the Quarters, that then the Tides do not hold out their full time, but is High-Water ſooner than is found by the Rule; which may partly be occaſioned by the Weakneſs of the Tide at ſuch a time, and the Length of the River: For by the foregoing Rule you may find, that when the Moon is 7 days old, the time of High-Water will be at 9 of the Clock, when upon true Obſervation it would be found to be an hour ſooner; and therefore to know the true Time of High-Water, you muſt ſubtract ſome minutes from the time found by the precedent Rule, according to the Age of the Moon, as you may plainly ſee in the annexed Table.

The

The Moon's Age					H.	M.
1	15	16	29	Subtract	0	0
2	13	17	28		0	5
3	12	18	27		0	10
4	11	19	26		0	20
5	10	20	25		0	30
6	9	21	24		0	45
7	8	22	23		1	00

Example.

The Moon being 7 days old, it is high Tide (by the Rule) at *London* at 9 of the Clock; then in this Table look for the Figure 7, which is in the firſt Column, and right againſt it in the two laſt Columns, under the Title of Hour and Minute, you will find one Hour, which muſt be ſubtracted from the Hour found by the Rule, and the Remainder is 8, the true Time of High-Water.

A Table ſhewing the Time of the Moon's coming to South, any Day of her Age.

Moon's Age		Moon's Southing.	
0	0	0	0
1	16	0	48
2	17	1	36
3	18	2	24
4	19	3	12
5	20	4	00
6	21	4	48
7	22	5	36
8	23	6	24
9	24	7	12
10	25	8	00
11	26	8	48
12	27	9	36
13	28	10	24
14	29	11	12
15	30	12	00

The Uſe of the Table to find the Time of the Moon's coming to South. The firſt and ſecond Columns ſhew the Days of the Moon's Age; in the third and fourth, the Hour and Minute of the Moon's coming to South.

Example.

The Moon being 10 days old, I would know at what Time the Moon will be South. I find 10 under the Title of the Moon's Age, in the firſt Column, and right againſt it, in the third and fourth Columns, you have 8 hours 00′; which ſheweth that the Moon being 10 days old, cometh to South at 8 of the Clock and no minutes; unto which if you add the time of flowing at Full and Change, the Sum will be the time of Full-Sea at the ſame Place. As here at *London*, the time of flowing at Full and Change is at 3 of the Clock, which you are to add to the Moon's Southing, and the Sum is 11. which is the time of High-Water when the Moon is 10 days old.

To

To find the Hour of the Night by the Shadow of the Moon upon a Sun-Dial.

Firſt, find her coming to South, as before; then ſee how many hours and minutes the ſhadow wants of the hour of 12; which hours and minutes take from the hour and minute of the Moon's coming to South, and the Remainder is the Hour of the Night; but if the ſhadow be paſt the Hour of 12, then you muſt add ſo many hours and minutes as the ſhadow is paſt 12, to the hour and minute of the Moon's coming to South, and that will be the hour of the Night.

Example.

On the 5*th* of *December* 1695, I find the Moon to be 10 days old, and therefore ſhe comes to the South juſt at 8 of the Clock; and ſuppoſe the ſame Night you look upon a Sun-Dial, and ſhould find the ſhadow to fall upon half an hour paſt 1, which is an hour and an half paſt the Line of 12; which Hour and an half muſt be added to 8, the Moon's Southing, ſhews it is half an hour paſt 9 of the Clock.

Again; ſuppoſe the ſame Night the ſhadow had fallen upon half an hour paſt 11, which wants half an hour of 12, which is to be ſubtracted from 8, the Moon's Southing, and the Remainder will be half an hour after 7 of the Clock.

CHAP.

CHAP. IX.

OF THE MARINER'S-COMPASS.

Of the *Variation* of the *Compaſs*, and the probable Cauſes thereof. Some Obſervations to find the *Variation*. The Deſcription and Uſe of the *Azimuth Compaſs*. Of the *Univerſal Ring-Dial*.

SECT. I.

Of the Original Diſcovery and Invention of the Mariner's Compaſs, *and the Excellency thereof.*

THIS moſt uſeful Inſtrument, called the *Mariner's Compaſs*, is juſtly ranked among the greateſt Wonders that this World affords, and deſerves well to be underſtood by all that are Students and Practitioners in the Art of Navigation: for without the help thereof, it were impoſſible to trace out the unbeaten Paths of the Ocean, for the procuring Trade and Traffick beyond the Seas to remote Parts of the World; whereby the glorious Goſpel hath been tranſmitted into the moſt dark Corners of the Earth.

As to the original Inventor hereof, Modern Hiſtorians do ſomewhat vary; ſome attribute the Invention thereof to one *John Goia* (or *Flavia*

Goia, as others ſtile him) of *Amalphi* in *Campania*, in the Kingdom of *Naples*, who only accommodated the *Superficies* thereof with 8 Points, that is 4 Cardinal, and four Collateral; and ſo left the Improvement of this Invention to be attempted by Poſterity. Others do entitle the Invention thereof to the People of *China*. Dr. *Gilbert* in his Book *De Magnete*, aſſerts, That *Paulus Venetus* tranſported it firſt into *Italy*, in the Year 1260, having learned it from the *Chineſes*. And *Ludi Vertomanus* affirms, That when he was in the *Eaſt-Indies*, about the Year 1500, he ſaw a Pilot of a Ship direct his Courſe by a Compaſs, faſhioned and framed as thoſe which now are commonly uſed.

And Mr. *Barlow*, in his Book entitled, *The Navigator's Supply*, *Anno* 1597, relateth a Story of two *Eaſt-Indians*, that he had perſonal Conference with, (one of them was of *Mamilia* in the Iſle of *Lazon*, the other of *Miaco* of *Japan*) who declared, that inſtead of our Compaſs, they uſe a Magnetical Needle of ſix Inches and longer, upon a Pin in a Diſh of white *China*-Earth, filled with Water, in the bottom whereof they have two Croſs Lines for the principal Winds, the reſt of the Diviſions being left to the Skill of their Pilots. Alſo he there relates, that the *Portugals*, in their firſt Diſcoveries of the *Eaſt-Indies*, got a Pilot of *Melinde*, that brought them from thence in thirty three days, within the ſight of *Calecut*; by which it appears that then they had the Uſe of the Compaſs.

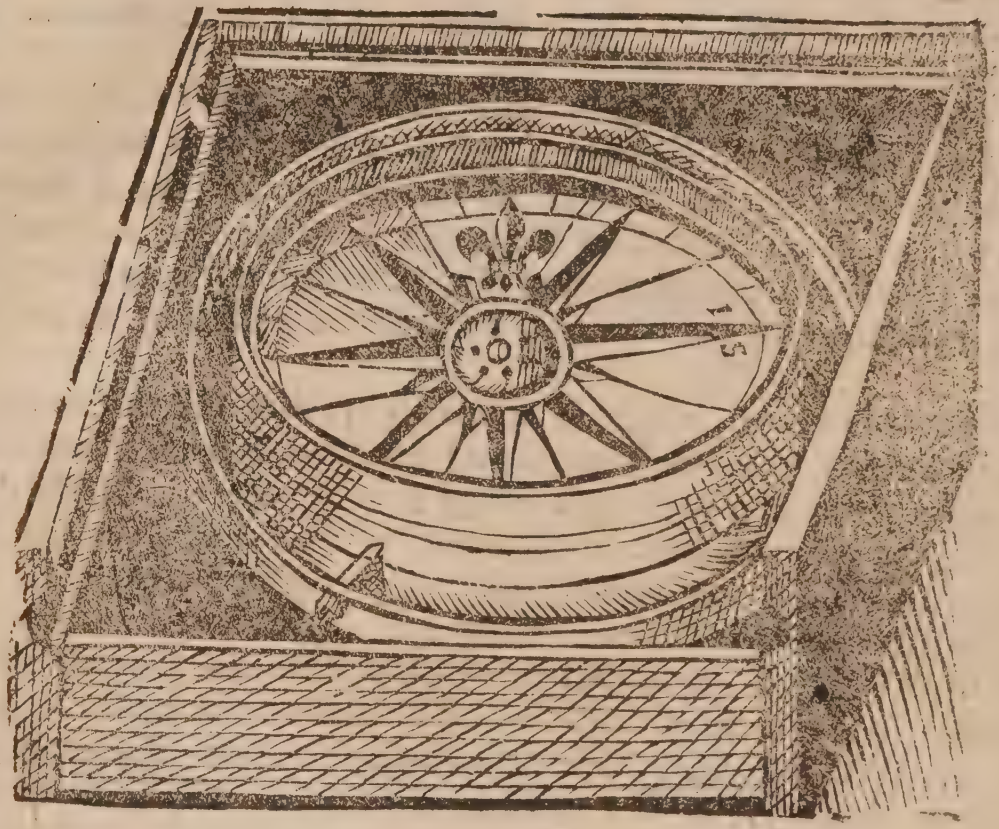
But let the Invention be attributed to whom it will, 'tis manifeſtly known to have received its abſolute Perfection in theſe Parts of the World; but more particularly, the compleating of this Invention is due to the People of *Antwerp* and *Bruges*, and alſo to our own Nation, by annexing to the Compaſs twenty four ſubordinate Winds or Points, and alſo on the Limb thereof 360 Degrees, which are numbred from North and South, towards the Eaſt and Weſt, with 10, 20, 30, *&c.* So that it appeareth, that every Point containeth 11° 15'. Upon the North Point there is a *Flower-de-luce*, to diſtinguiſh it from the reſt of the Points.

Before the Invention of this rare Inſtrument, Men were directed in their Voyages by certain Stars they took notice of, eſpecially the *Pleiades*, or *ſeven Stars*, by *Charles's Wain*, and the two Stars in the Tail of the *Little Bear*, which were therefore called Load-Stars. Alſo Travellers in the Deſarts of *Arabia*, and thoſe of *Tartaria*, were guided by ſome fixed Stars in the Night-time, to ſteer their Courſes in thoſe pathleſs, diſordered, and unhoſpitable Ways. So Seamen were directed by the like Heavenly Guides, in the untractable Wilderneſs of Waters, and unbeaten Paths of the Ocean, before this excellent Artifice was diſcovered. But if the Sky happened to be ſullied with Miſts, and the Stars to be muffled with Clouds, there the moſt experienced Mariner was at a loſs, and was conſtrained to come to an Anchor, or to lie by, to wait the Appearance of his Celeſtial Directors. And if you conſult *Pliny*, he will tell you of the Inhabitants of *Taprobana*, now called *Sumatra*, becauſe they could not behold the *Pole-Star* to ſail by, carried certain Birds to Sea, which they did often let fly: and as thoſe Birds by natural Inſtinct applied their Flight always to Land, ſo the Mariners directed their Courſe after them.

To theſe and the like Difficulties were Men expoſed before the Invention of this marvellous Inſtrument; and by it Poſterity is ſecured with a noble Remedy againſt this grand Inconvenience; and a Method diſcovered, as by an immediate Meſſenger from Heaven, to ſteer an infallible Courſe in the moſt gloomy Nights, and tumultuous Seas, and by the Providence of the Almighty be ſafely conducted to the deſired Port.

Yet this Inſtrument is not ſo abſolutely perfect (by that acquired Virtue it receives from the Load-ſtone) but that it requires ſome Improvements, becauſe it doth not conform it ſelf to the true Meridian in all Places, but varies in ſome Places more, in ſome leſs, from the direct Poſition of the true North and South. This Variation of the Compaſs augments the Mariners Care, and ought to be conſtantly obſerved in all Voyages, the neglect of which may expoſe them to many Dangers. A Diſcourſe of the *Variation*, and of the probable Conjectures of the natural Cauſe thereof, is handled in that which follows. I thought it neceſſary (for Method-ſake) to ſubjoin the Figure of the *Mariner's Compaſs.*

The Figure of the Mariner's COMPASS.



SECT. II.

A Diſcourſe of the Variation *of the* Compaſs, *and of the Natural Cauſe thereof; with* Obſervations *of the* Variation.

THE *Variation* of the *Compaſs*, is an Angle intercepted between the Magnetical and true Meridian, the Horizon determining its Quantity and Quality. Theſe Meridians ſometimes are co-incident in ſuch places where there is no *Variation*; ſometimes again they are different; and then that part of the Horizon wherein the Northern extremity of the Needle lies, denominates its Quality: for if it be to the Eaſtward, then it is called Eaſterly Variation; if to the Weſtward, then Weſterly.

And for the Reaſons of the Natural Cauſe of the Variation, it is granted (by the Judicious) that the great Globe of the Earth whereon we move, is a Magnetical Body: and Experience doth manifeſtly prove, if you take notice of the univerſal Conformity of the Compaſs or Magnetical Needle, to the North and South Poles of the World, which is thereunto attracted by the Magnetical and diſponent Faculty of the great Magnet the Earth, by whoſe Magnetick Vigor it is held and ſuſtained in that Poſture. For a Magnetical Body is not that only which hath a Power attractive, but alſo directive, by a natural Propenſity diſpoſing it ſelf to one invariable and fixed Reſidence; ſo that if a Magnetical Body, Needle, or Compaſs be violently removed, yet would it not abandon its primitive Points, or ſwerve from its Meridional Polarity, but return to its natural Situation. And ſuch a Magnetical Virtue is diffuſed through the whole Body of the Earth, whereby it conſtantly addreſſeth it ſelf to the Poles, being ſo conſtituted in its whole Frame, Order and Aſpect, unto theſe Points, that the attractive Vigor thereof is not confined or lock'd up within its inward Cells and Receſſes, or circumſcribed within the Circumference of its own Surface, but diſplayed at intermediate Diſtances, notwithſtanding the Interpoſition of the Water, Air, and other interjacent Bodies whatſoever, tho never ſo ſolid, through all which it doth excite and tranſplant its Magnetical Virtue into all Bodies fitly qualified, within and without it; and effecting this in an abſtruſe and indiſcernable way, the which we may ſee viſibly performed by the Load-ſtone: For theſe *Effluviums* penetrate all Bodies, capable of their vigorous and active Excitation; as is apparently manifeſt in all magnetical Needles, having received Strength from the Load-ſtone.

As

An Experiment to prove that the natural Cauſe of the Variation (of the Magnetical Needle) proceeds from the Magnetiſm of the Earth.

Take a vigorous Magnet, and let it be converted into a ſpherical Body, and having found its Poles, delineate the ſame with Meridians, the Equinoctial, and Parallels; then take a ſmall Magnetical Needle on a Pin, and if you apply this Needle to the Equinoctial of the ſaid Stone, the Needle will lie parallel to the *Axis* thereof; and if you move it towards either Pole, the Needle will immediately incline towards the ſaid Pole, according as you move it, until you come to the Pole; then will one Part of the Needle point directly to the very Pole of the Stone.

But if this ſpherical Magnet ſhall have a Part of it excavated, then if you move the Needle about the Stone, as before, ſo ſoon as it ſhall draw near to the Limb of this Excavation, 'twill in its Courſe of moving ſuddenly alter, and encline to one of the ſolid Sides, not at all reſpecting the aforeſaid Poles: And this Deflection may explain the *Variation of the Needle*; and the greater will this *Variation* be, the nearer it approacheth to the Poles: for whereas before the Excavation, each ſide being alike potent, the Needle enclined according to its natural Poſition; but meeting with this Accident the Excavation, it will convert it ſelf to the more ſolid Side, rejecting the imperfect and defective; and ſo much the more powerfully, by how much the defective Part hath loſt of its magnetical and vigorous Subſtance.

And as it is with this little, ſo likewiſe may it be with the greater Magnet, the Earth, whoſe ſolid magnetical Parts are great Continents; the defective and excavated, the deep and vaſt Channel of the Sea: and therefore the Cauſe of *Variation* may be the inequality of the Earth, variouſly diſpoſed, and differently mixed with the Sea; and all the different Emiſſion of its Strength and Magnetical Vigour, from the more eminent and gibbous, and from the more hollow and excavated Parts thereof. So the Needle naturally endeavours to conform unto the Meridian, being alſo detracted that way, where the greater and more powerful Parts of the Earth are ſituated.

To this may be added, That the *Variation* proceedeth not only from ſome eminent Terreſtrial Knobs or Excreſcencies, which appear like ſo many Wens upon the Face of the Earth, as alſo from many magnetical Veins of the Earth, collaterally reſpecting the Needle; but likewiſe from the different Accumulation of the Earth, diſpoſed unto the Poles, lying under the Sea and Waters, which affect the Needle with a greater or leſſer *Variation*, according to the Vigor or Impotency of the *ſubterraneous Lines*, or the entire or broken Body of the *magnetical Fabrick* under it; as is obſervable from ſeveral Load-ſtones, placed at the bottom of any Water: for a Needle upon the Surface, will variouſly conform it ſelf according to the *Vigor* or *Imbecillity* of the Load-ſtones under it.

The Globe of the Earth is known to be very uneven, and unequally mixed with many Materials, differing from a magnetical Quality, having great and ſtony Mountains, large Vallies, deep Seas, long and high Continents and Promontories, with mighty ſcattered Rocks of Load-ſtones, of Iron Mines, and other Magnetical Matters.

This *Variation* of the *Compaſs* was formerly ſuppoſed to remain the ſame, but now 'tis known to vary in all Places: to illuſtrate this Truth, I ſhall here inſert ſome Obſervations of the *Variation* of the *Compaſs* near the City of *London*, for an hundred Years laſt paſt.

Mr. Burroughs *his Obſervation of the Variation made at* Lime-Houſe, October *the* 16*th*, 1580.

Before-Noon.				After-Noon.						
Sun's Alt.		Mag.Azim.		Sun's Alt.		Mag.Azim.		Variation.		
Gr.	min.	Gr.	min.	Gr.	min.	Gr.	min.	Gr.	min.	
17	00	52	35	17	00	30	00	11	17	Mean Variation 11° 17′ from the North-Eaſtward.
18	00	50	08	18	00	27	45	11	11	
19	00	47	30	19	00	24	30	11	30	
20	00	45	00	20	00	22	15	11	22	
21	00	42	15	21	00	19	30	11	22	
22	00	38	00	22	00	15	30	11	15	
23	00	34	40	23	00	12	00	11	20	
24	00	29	35	24	00	07	00	11	17	
25	00	22	36	25	00	00	28	11	04	

Mr.

Mr. Gunter's *Obſervations, made at* Lime-Houſe, June 13. Anno 1622. *Afternoon.*

Sun's Alt.		Mag. Azim.		Sun's Azim.		Variation.		
Gr.	min.	Gr.	min.	Gr.	min.	Gr.	min.	
19	00	82	02	75	52	06	10	Variation, 5° 55′ Eaſtward.
18	05	80	50	74	44	06	06	
17	34	80	00	74	06	05	54	
17	00	79	15	73	20	05	55	
16	18	78	12	72	32	05	40	
16	00	77	50	72	10	05	40	
10	10	71	02	64	49	06	13	
09	52	70	12	64	25	05	47	

In this Interval of the Obſervations made by Mr. *Burroughs* and Mr. *Gunter*, in 42 Years, the evident Diminution hath been 5 degrees.

Mr. Gillibrand's *Obſervations, made at* Deptford, Anno 1634. June 12. *before noon.*

Alt.Sol.Vera.		Azim. Mag.		Azim. Sol.		Variation.	
Gr.	min.	Gr.	min.	Gr.	min.	Gr.	min.
44	45	106	00	110	06	04	06
46	30	109	00	113	10	04	10
48	31	113	00	117	01	04	01
50	54	118	00	122	03	04	03

In the Afternoon the ſame Day.

Alt.Sol.Vera.		Azim. Mag.		Azim. Sol.		Variation.	
Gr.	min.	Gr.	min.	Gr.	min.	Gr.	min.
44	37	114	00	109	53	04	07
40	48	108	00	103	50	04	10
38	46	105	00	100	48	04	12
36	43	102	00	097	56	04	04
34	32	099	00	095	00	04	00
32	10	096	00	091	55	04	05

The mean of which Obſervation is 04° 06′ Eaſtward.

Obſervations made by Mr. *Gillibrand* at *Paul's Cray* in *Kent*, *July* 4. 1634. Afternoon.

Vera.Alt.Sol.		Azim. Mag.		Azim. Sol.		Variation.	
Gr.	min.	Gr.	min.	Gr.	min.	Gr.	min.
40	55	111	30	107	30	04	00
40	01	110	00	106	05	03	55
39	41	109	30	105	34	03	56
38	42	108	00	104	05	03	55
35	32	103	30	99	32	03	58
34	49	102	30	98	32	03	58
33	41	101	00	97	00	04	00
32	57	100	00	96	02	03	58
32	09	99	00	94	58	04	02
31	25	98	00	94	00	04	00
30	39	97	00	93	01	03	59
29	29	95	30	91	31	03	59
27	51	93	30	89	28	04	02

The mean Variation is 4° 01′ Eaſtward.

So that here alſo may be noted, that the Diminution of the Variation in 45 Years (from the time of Mr. *Burrough*'s Obſervations) is more than 7 degrees.

Obſervations made by *John Seller*, at the *Hermitage* near *London*, with a Quadrant of 6 Foot Radius for the Altitude; and an Inſtrument of two Foot Radius for the *Azimuth*, taken in the Year 1666. Lat. 51 deg. 32 min.

June the 4*th*, 1666, *in the Forenoon.*

Sun's Alt.		Sun's Azim.		Mag. Azim.		Variation.	
°	′	°	′	°	′	°	′
26	00	84	36	85	00	00	24
27	30	86	26	87	00	00	34

June the 13*th*, 1666, *in the Afternoon.*

08	24	62	31	62	00	00	31
08	09	61	51	61	30	00	21
07	38	61	29	60	45	00	44
07	07	60	47	60	00	00	47

June the 14*th*, 1666, *in the Forenoon.*

29	30	88	40	89	30	00	50
31	20	91	03	91	30	00	27

The Mean of theſe Obſervations is 34 minutes Weſterly.

May the 28*th*, 1670, in the Afternoon, taken by the Worſhipful Sir *Nicholas Millet*, at his Houſe at *Batterſey*.

24	30	83	34	81	40	1	54
20	30	78	44	76	35	2	09
17	03	74	32	72	18	2	14
15	42½	72	54	70	40	2	14
13	36½	70	18	68	10	2	08
11	11	67	14	65	15	1	59
10	11	75	58	63	45	2	13

The mean Variation is 2° 06′ Weſterly.

Mr.

Mr *Bond's* Theory of the Motion of the Variation for time to come, to the intent that it may be manifeſted by Obſervations, the Verity or Invalidity of this pretended Theory.

Years.	Variation Weſt.		Years.	Variation Weſt.	
	Gr.	M.		Gr.	M.
1689	5	29	1703	7	36
1690	5	39	1704	7	45
1691	5	48	1705	7	53
1692	5	57	1706	8	01
1693	6	06	1707	8	09
1694	6	19	1708	8	17
1695	6	25	1709	8	25
1696	6	34	1710	8	33
1697	6	43	1711	8	41
1698	6	52	1712	8	49
1699	7	01	1713	8	56
1700	7	10	1714	9	04
1701	7	19	1715	9	11
1702	7	28	1716	9	$17\frac{1}{2}$

SECT. III.

The Deſcription and Uſe of the Azimuth-Compaſs.

THis Compaſs doth derive its Name from its Uſe, being principally to find the *Magnetical-Azimuth* of the Sun, and is in ſeveral reſpects like unto another Compaſs, only with ſuch neceſſary things added, as are moſt convenient for that purpoſe.

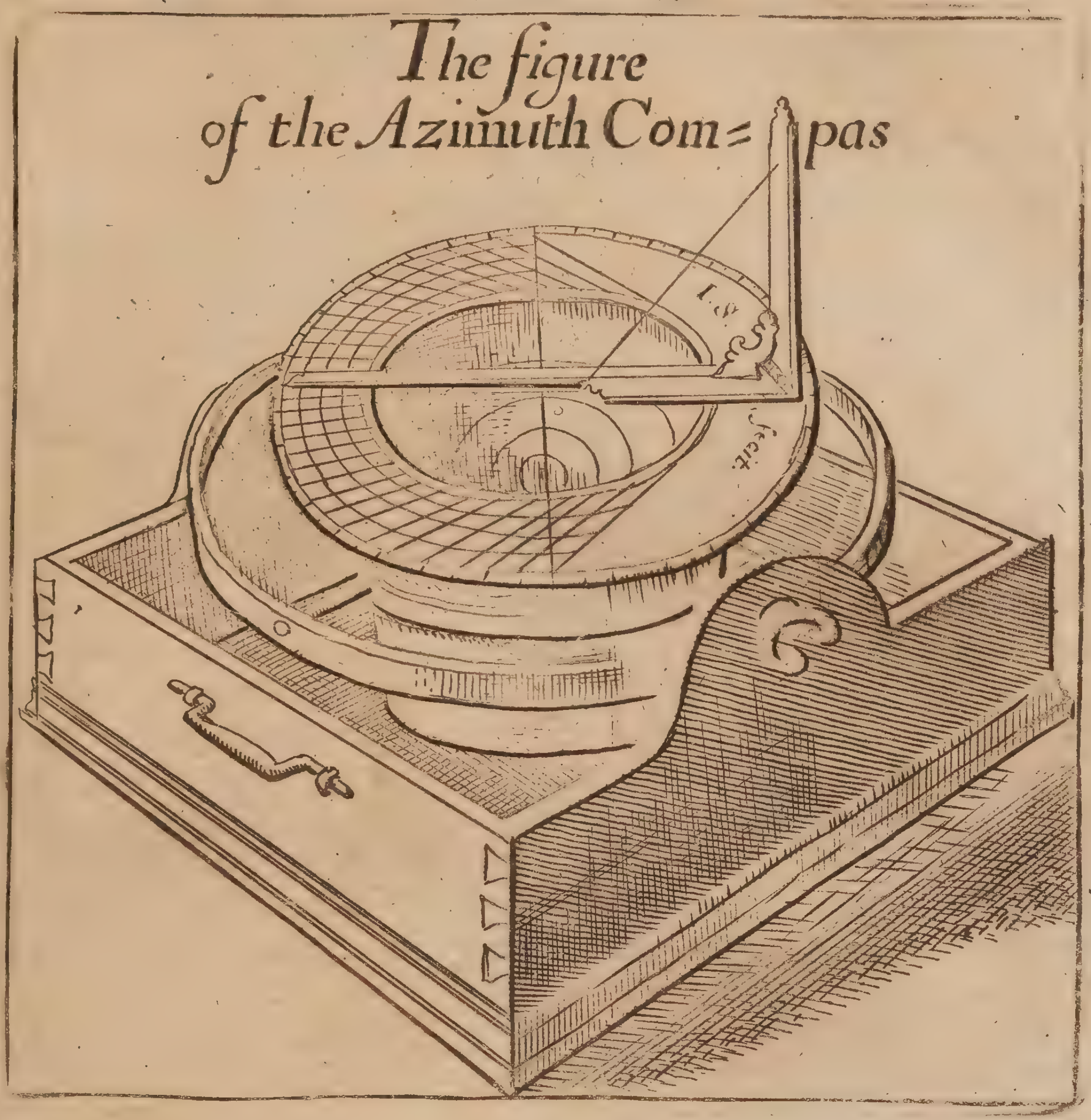
Upon the round Box, wherein are the Fly and Needle, is faſtened a broad Circle of Braſs, the one half of the Limb thereof is divided into 90 degrees, numbred from the middle of the ſaid Diviſions both ways, with 10, 20, 30, *&c.* unto 45 degrees; which degrees are alſo ſubdivided into minutes by *Diagonal* Lines, and by certain *Excentrick Circles* interſecting one another; for theſe degrees are drawn from the oppoſite part of the Limb whereon the Index moveth, cutting thoſe degrees. On this Index is erected a Sight, which for conveniency is to fall down with a Hinge, and to ſet up upon Occaſion; and from the top of this Sight, down to the middle of the Index, is faſtened a Thread or Lute-ſtring, to ſhew the Shadow of the Sun upon a Line that is on the middle of the ſaid Index.

And by this means of placing the Index upon the Circumference, the degrees come to be as large again as they would be, if it moved upon the Center; the Truth hereof is evidently demonſtrated in the third Book of *Euclid*, Prop. 20.

This broad Circle is croſſed at Right-Angles with two Strings; and commonly from the Terminations of theſe Strings are drawn four ſmall black Lines on the inſide of the Box, for rectifying the Inſtrument in time of Obſervation, by the four Lines that are alſo drawn at Right-Angles, on the Superficies of the Fly.

This Compaſs being thus fitted, is hung in ſtrong Braſs Rings, and thoſe alſo faſtened into a Square Wainſcot Box, fit for that purpoſe; which you may more plainly perceive in this following Figure.

The


The figure
of the Azimuth Com= pas

The Uſe of the Azimuth-Compaſs.

Firſt, You muſt rectify the Braſs Limb on the Edg of the Box (by the Needle and Fly within the Box) according as the nature of the Obſervation doth require: For if the Obſervation be in the Forenoon, then you muſt put the Center of the Index upon the Weſt Point of the Card or Fly within the Box; and ſo, that the four Lines on the Edg of the Card, and the four Lines by the inſide of the Box, do always concur.

The Inſtrument being thus rectified, turn the Index towards the Sun, until the Shadow of the *Hypotenuſal Thread* fall directly into the very ſlit of the Sight that is on the Index, and alſo upon a Line that is in the middle of the Index; then at the ſame time will the inner Edg of the Index cut the degree and minutes of the Sun's Magnetical Azimuth from the Eaſt to the Northward or Southward.

As for Inſtance.

Suppoſe the Inſtrument be rectified, as before is ſhewn, for an Obſervation in the Forenoon, and that the Index ſhould cut ten degrees upon the Limb to the Northward of the Eaſt, then is the Azimuth of the Sun 80 degrees from the North, or elſe 100 degrees from the South. So likewiſe if the Index had cut 10 degrees to the Southwards of the Eaſt, then would the Azimuth be 80 degrees from the South, and 100 from the North.

And here alſo obſerve, That the Compaſs ſtanding in this Poſition, and if the Azimuth of the Sun be leſs than 45 deg. from the Meridian, and you turn the Index toward the Sun, it will go off the Diviſions on the Limb, and there can be no uſe made thereof as it now ſtands.

Therefore you muſt turn the Inſtrument juſt one Quadrant, or quarter of the Compaſs, *viz.* place the Center of the Index on the North or South Point of the Chard, according to the Sun's Poſition from you, and then the Edg thereof will cut the degree of the Sun's Azimuth, from the North or South. That which is ſaid as to the Uſe of the Azimuth-Compaſs, when the Sun is on the Eaſt-ſide; the like is to be underſtood with the ſame reaſon, when he is on the Weſt-ſide of the Meridian.

And alſo note, That the Obſervations of the Sun's Azimuth are beſt, when the Sun is near the Horizon, becauſe the Motion of the Sun in his Altitude is more eaſily obſerved.

To take an Amplitude by the Azimuth-Compaſs.

If the Amplitude be taken in the Morning, at the riſing of the Sun, then you muſt turn the Center of the Index right over the Weſt-point of the Fly, and rectify the Inſtrument by the Lines within the Box, to the Lines on the Fly.

Then looking through the Sight, turn the Index towards the Sun, until you cut the Body of the Sun with the Thread; at the ſame time will the edg of the Index ſhew the degree of the Sun's Magnetical

Amplitude, upon the Limb of the Inſtrument, from the Eaſt, either Northerly or Southerly.

But if you take the Amplitude in the Afternoon, at the Setting of the Sun, then you muſt turn the Index over the Eaſt Point of the Fly, and proceed as before.

Having found the Magnetical Azimuth or Amplitude by the Compaſs, find the Sun's Azimuth by *Problem* 13. *Chap.* 8. and the Sun's Amplitude by *Problem* 8. *Chap.* 8.

Then find the Difference between the Sun's Azimuth or Amplitude, and the Magnetical Azimuth or Amplitude, by ſubtracting the one from the other ; this Difference is the Variation of the Compaſs. And to know whether the Variation be Eaſterly or Weſterly, obſerve theſe following Rules.

Rules for caſting the Variation.

I. By the Obſervation of the *Azimuth.*

In the Forenoon.

1. If the Angle of the Sun's Azimuth (by Calculation) from the North be greater than the Magnetical Azimuth (by Obſervation) then is the Variation Eaſterly.

2. If the Angle of the Sun's Azimuth from the North be leſs than the Magnetical, then is the Variation Weſterly.

In the Afternoon.

3. If the Sun's Azimuth from the North be greater than the Magnetical, then is the Variation Weſterly.

4. If the Sun's Azimuth from the North be leſs than the Magnetical, then is the Variation Eaſterly.

Example 1.

Suppoſe on the 4*th* of *June* 1690, in the Forenoon, I ſet the Sun with my Azimuth-Compaſs, and find his Magnetical Azimuth to be 90° 48′ from the North, at the ſame time the Sun's Azimuth, by Calculation, is 84° 30′ from the North part of the Meridian.

The difference of theſe Azimuths (which is the Variation) is 06° 18′; I demand which way the Compaſs varies?

Anſw. Weſterly; becauſe that Obſervation being made in the Forenoon, and I find the Sun's true Azimuth from the North to be leſs than the Magnetical, according to the ſecond Rule aforegoing.

Example 2.

Admit that in the Afternoon, at the ſame time that I find the Sun's Azimuth to be 102° 00′, I find his Magnetical to be 96° 00′ from the North.

The difference is 06° 00′; I demand which way the Compaſs varies?

Anſw. Weſterly; becauſe the Obſervation being made in the Afternoon, I find the Sun's Azimuth from the North to be greater than the Magnetical, according to the third Rule.

Note, Theſe four Rules for caſting the Variation, by Obſervation of the Sun's Azimuth, are the ſame in South as in North Latitude, the Sun's Declination being either Northerly or Southerly.

II. By the Obſervation of the Amplitude.

At Sun-Riſing.

1. If the Sun's Amplitude be nearer to the North than the Magnetical, then is the Variation Weſterly.
2. If the Sun's Amplitude be farther from the North than the Magnetical, then is the Variation Eaſterly.

At Sun-Setting.

3. If the Sun's Amplitude be nearer to the North than the Magnetical, then is the Variation Eaſterly.
4. If the Sun's Amplitude be farther from the North than the Magnetical, then is the Variation Weſterly.

Example.

Admit that by the Azimuth-Compaſs, at Sun-Setting, I find the Magnetical Amplitude to be 19 deg. 00 min. and the Sun's Amplitude to be 24 deg. 00 min. from the Weſt Northerly; I demand which way the Compaſs varies?

Anſw. Eaſterly; becauſe by an Obſervation at Sun-ſetting, the Sun's Amplitude is nearer to the North than the Magnetical, according to the third Rule.

Having by the former Rules found the Quantity and Quality of the Variation, it yet remains there be ſome Directions for rectifying the Courſe.

The Manner that I ſhall here ſet down, is performed by a Compaſs-Chard (having Degrees on the Limb) and a pair of Compaſſes, which tho it be mechanical, yet it is facile and demonſtrative, and in my Opinion, exact enough for Nautical Uſes; however, any one may uſe the Pen if he pleaſe.

But before we deliver the Rule for Operation, it will not be amiſs, for plainneſs ſake, to give theſe Cautions.

1. That when a Man directly beholds the North part of the Horizon, the Eaſt is on the Right-hand, and the Weſt on the left; and therefore when the North-point of the Compaſs (and conſequently all the other Points) vary from the true North or Meridian to the Eaſtward, then the Variation is reckoned to the right-hand; and for the ſame reaſon, if the Variation be Weſterly, it's accounted to the left.

2. That in the Uſe of the Compaſs-Chard, you muſt always obſerve, that you place the Courſe, or Point on which you ſteer, right from you.

The Rule.

Take the quantity of the Variation in degrees, from the Limb of the Chard, between the Compaſſes (the Chard lying before you, as is directed) placing one Foot in the Rhomb or Courſe; if the Variation be Eaſterly, turn the other Foot towards the right-hand; but if Weſterly, to the left: the number of degrees in which the Point of the Compaſs ſtays, ſhews the true Courſe from the North or South, either Eaſterly or Weſterly, the Quantity and Quality of the Variation being allowed.

As for Example.

1. Let the Magnetical Rhomb, or Point of the Compaſs, be North-Eaſt, and the Variation 10 degrees Eaſterly; I demand the true Rhomb.

The Chard lying as is directed, take the Extent of 10 degrees between the Compaſſes, and place it from the North-Eaſt towards the right-hand, becauſe the Variation is Eaſterly, that ſhews the true Courſe to the North-Eaſt 55 degrees, or N. E. by E. a little Eaſterly.

2. Let the Courſe by the Compaſs be Weſt and by South (*i. e.*) S. W. 78 deg. 45 min. and the Variation 10 deg. Eaſterly, as before, I demand the true Rhomb.

Take the Extent of 10 degrees between your Compaſſes, and place it from W. by S. towards the Right-hand; it ſhews the true Rhomb to be S. W. 88 deg. 45 min. or almoſt Weſt.

3. Let the Magnetical Rhomb be Weſt, and the Variation 10 degrees Eaſterly, I demand the true Courſe.

Take the Extent of 10 degrees, as before, ſet it off from the Weſt towards the Right-hand, it gives the true Rhomb North-Weſt 80 deg. 00 min. or almoſt Weſt by North.

4. Let the Magnetical Rhomb be N. N. W. the Variation 10 deg. Weſterly, I demand the true Rhomb.

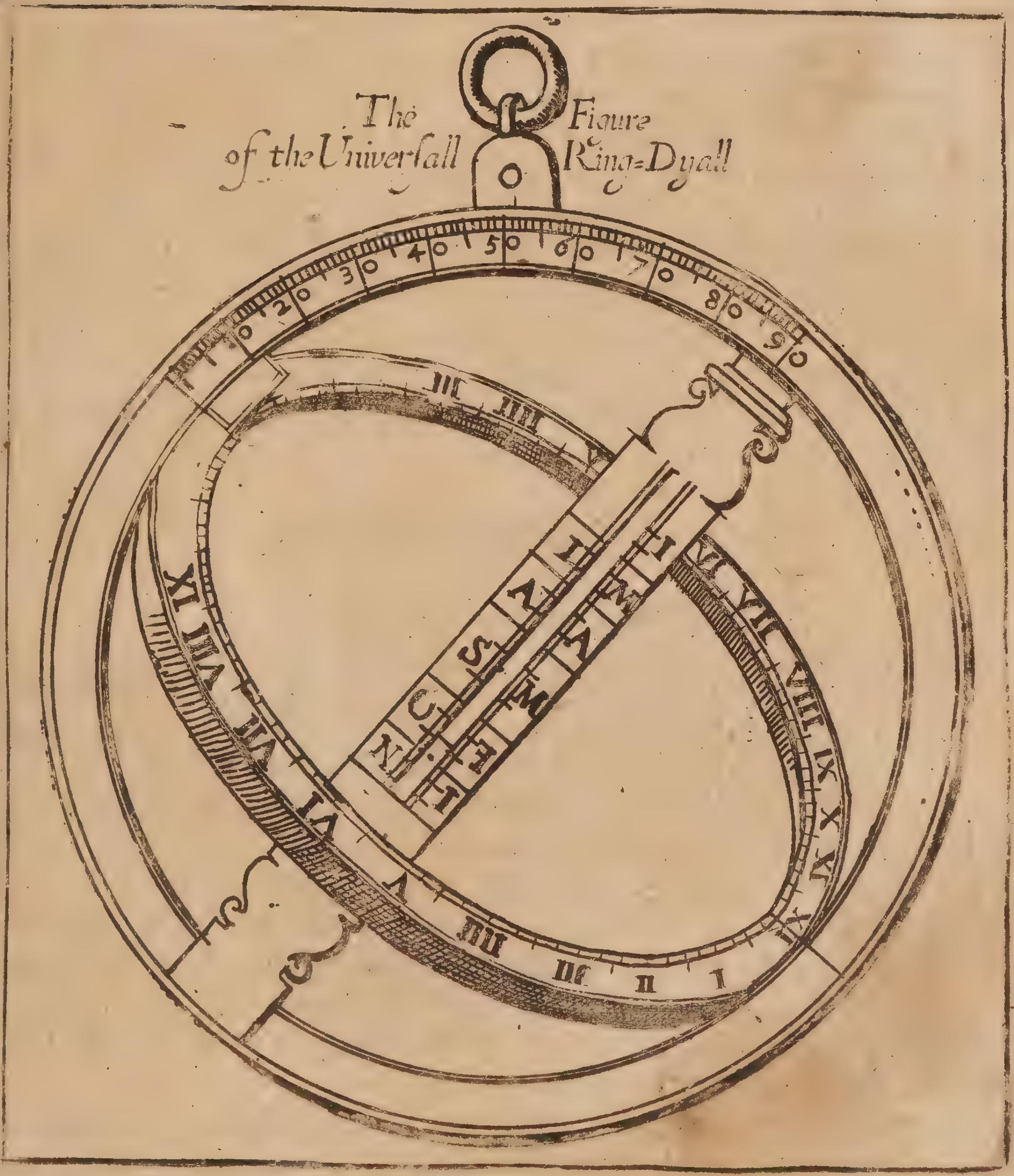
Take the Extent of 10 degrees, place it from the N. N. W. towards the Left-hand, becauſe the Variation is Weſterly, it gives the true Rhomb N. W. 32 deg. 30 min. or almoſt N. W. by N.

5. Let the Courſe by the Compaſs be Weſt, the Variation 10 deg. Weſterly, I demand the true Courſe.

Take the quantity of the Variation 10 deg. place it from the Weſt towards the Left-hand, which ſhews the true Rhomb to S. W. 80 deg. or almoſt W. by S.

SECT. IV.

The Deſcription of the Univerſal Ring-Dial.



THis Inſtrument conſiſts chiefly of two Rings, cloſely fitting within each other, and a Bridg, and is made either of Braſs or Silver.

The outermoſt Ring repreſents the Meridian of the Place, and on the foreſide has one of its upper Quadrants divided into 90 degrees; likewiſe on the backſide a Semicircle is divided into the like Number of degrees from the Hole or Centre in the Circumference. On the Convexity of this Ring is fitted a Nut (with a Wire-Ring to it) having a ſmall Line drawn in the middle of it, to remove to any of the degrees on the foreſide.

The inner Ring (when they are open at Right-Angles) repreſents the Equinoctial Circle, on the inſide of which is drawn a Line in the very midſt, and thereon are divided the Hours into Halves and Quarters, and are numbred with their proper Figures on the upper ſide of this Ring.

The Bridg repreſents the Axis of the World, in the middle whereof there is cut a long ſlit; upon one ſide are placed the Days of the Month, on the other the Degrees of the Sun's Declination: upon the Bridg is contrived a ſliding Nut, which directs a ſmall Plate moving within the ſlit; this Plate is croſſed with a fine Diviſion, and in the midſt thereof is drill'd a ſmall Hole.

The Uſe of the Ring-Dial.

To find the Hour of the Day.

Place the Hole that is on the ſmall Plate on the Bridg, to the Day of the Month, or the Sun's Declination, and ſet the Nut upon the Convexity of the outer Ring, to the degrees of the Place's Latitude (whether Northerly or Southerly) on the foreſide of the Ring: open the Rings to Right-Angles, and then having your Inſtrument on your Finger, turn the upper end of the Bridg towards the elevated Pole, and place the flat ſide of the Bridg againſt the Sun, that his Rays may the better tranſpierce the little Hole; then turn the Inſtrument to the Sun, until the Sun-beams (by the little Hole) fall exactly upon the Line drawn on the inſide of the Equinoctial or inner Ring; then is ſhewn the Hour of the Day, according to the Capacity of the Inſtrument.

The dividing the degrees of the Sun's Declination on the Bridg of this Inſtrument (which I purpoſely omitted) is Geometrically deſcribed by the Worthy Mr. *Edward Wright*, in his *Correction of Errors*, who, I think, was the firſt Contriver of this Univerſal Dial, altho differing from this here diſcourſed of.

To find the Sun's Altitude.

To perform this, you muſt firſt ſet the Line in the midſt of the Nut, upon the outer Ring, to the beginning of the degrees on the foreſide of the ſame; then put a Pin in the Center-hole, and hanging your Dial upon your Finger, turn the edg of the outer Ring towards the Sun, ſo as the Shadow of the Pin may fall upon the Diviſions on the back-ſide; the degrees cut by the Shadow is the Sun's Altitude.

Note.

If you uſe the Ring-Dial in South-Latitude, you muſt place the Hole in the ſliding Plate on the Bridg, to the Sun's Declination, uſing the South Declination inſtead of the North, and the contrary.

CHAP. X.

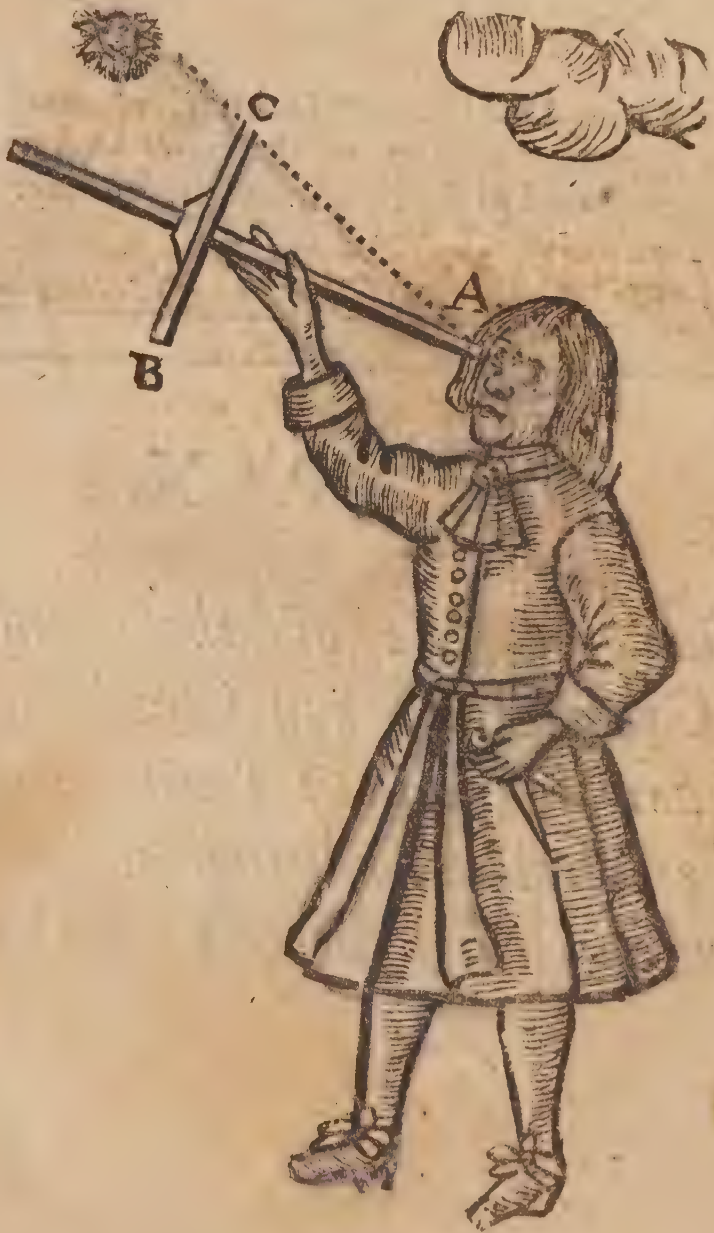
Containing the Uſe of theſe Inſtruments, the Croſs-Staff, *and* Quadrant: *Likewiſe how to find the Latitude of a Place by the Meridian-Altitude and Declination of the Sun; and the Uſe of the* Nocturnal.

The

The Figure of the Croſs-Staff and the Manner of Obſervation.

SECT. I.

The Deſcription and Uſe of the Croſs-Staff.



This Inſtrument is of ſome Antiquity in Navigation, and is commonly uſed at Sea, to take the Altitude of the Sun or Stars, which it performs with ſufficient Exactneſs, eſpecially if it be leſs than 60 degrees; but if it exceed 60, it is not ſo certain, by reaſon of the length of the Croſs, and the ſmallneſs of the Graduations on the Staff.

The Staff is made ſtreight, four-ſquare, and commonly of Box, or Pear-Tree, and graduated on the ſeveral Sides with Degrees and Minutes.

The Croſſes, uſually four, are commonly made of the ſame Wood with the Staff, of a convenient breadth, and of length proportional to the Graduations, fitted to ſlide evenly upon the Staff, without jogging.

On one ſide of the Staff, the Graduations begin about three degrees, and proceeding towards the Center or Eye-end, encreaſe by every ten minutes to ten degrees; and this Side is called the Ten-ſide; ſometimes the Breadth of the thirty-Croſs ſupplies the place of the Ten-Croſs.

On another ſide of the Staff, the Diviſions begin at about three 10°, and encreaſe upwards to 30°; this is called the Thirty-ſide.

On another ſide the Graduations begin about 20°, and encreaſe towards the Eye-end of the Staff to 60°; this is named the Sixty-ſide.

The remaining and fourth ſide hath the Diviſions beginning at 30°, and encreaſing upwards to 90°; from thence it is named the Ninety-ſide, and his Croſs (the longeſt) the Ninety-Croſs.

Sometimes the ſeveral ſides of the Staff are numbred likewiſe with their Complements to 90° in ſmall Figures, *viz.* at 90° ſtands 00, againſt 80° 10°, at 70° ſtands 20°, and ſo of the reſt.

The Uſe of this is to take the Complement of the Altitude, or Zenith-diſtance from the Staff, without Subtraction.

A Table of the Lengths and half-Lengths of the Croſſes; ſhewing the Meaſure of each Croſs by the Graduation on the Staff, proving whether they be rightly made or not.

Croſſes.				Whole Length of the Croſſes.		Half Length of the Croſſes.	
				Degrees.	Minutes.	Degrees.	Minutes.
10	From	10	to	08	31	09	12
30		30		19	47	23	52
60		60		30	00	40	13
90		90		36	52	53	07

An Example of the Sixty-Croſs.

The length of the Sixty-Croſs (if rightly made) muſt reach from 60° to 30° 00′; and his half-length to 40° 13′.

There are two ways principally for the graduating a Croſs-Staff, one by Geometrical Projection, the other by Arithmetical Calculation.

I will give you an Example of the latter, by which you may divide any Staff, or at leaſt be able to examine one that is already graduated.

Example of the Sixty-Croſs.

Suppoſe the length of the Sixty-Croſs to be 10 $\frac{2}{10}$ Inches, and the half-length 5 $\frac{1}{10}$ Inches; I deſire to know the Diſtance of 45° 30′, from the Center of the Staff proportional to this length of the Croſs. Take half of 45° 30′, that is 22° 45′.

The Proportion is,

As the Tangent of 22° 45′, ———————— 9.62256
Is to the half length of the Croſs, 5 $\frac{1}{10}$ Inches, ———— 0.70757
So is Radius ———————————— 10.00000

To the Diſtance required, 12. 16 Inches, ———— 1.08501

This gives the Diſtance from the Center of the Staff to the Diviſion, repreſenting 45° 30′ to be 12. 16 (or $\frac{16}{100}$) Inches.

But if you do propoſe to graduate a Staff, the more ready and expedite way is to divide the half-length of the Croſs into 100 or 1000 equal parts, and taking only the Tangent Complement of half the Angle required, out of a Canon of natural Tangents, gives the Diſtance required.

Example.

Suppoſe, as before, the half-length of the ſixty Croſs, to be 5 $\frac{1}{10}$ Inches, and it is required to know the Diſtance from the Center to 45° 30′.

The half length of the Croſs being divided into 1000 equal Parts, (or into as many as conveniency admits of, the reſt ſupputated by Eſtimation) look into the Tables of natural Tangents, for the Tangent Complement 22° 45′, (the half of 45° 30′) and you will find 238472; then cutting off two Figures towards the right-hand, the Remainder 2384, ſhews the Number of equal Parts (whereof the half-Croſs contains 1000) which muſt be taken, to ſet off the Diſtance from the Center to 45° 30′, that is twice the half-length of the Croſs, and 384 Parts more.

The like you may perform for any other Degree, to every tenth or fifth Minute, or leſs, according as the Staff will admit of the Diviſions; and as you ſee in the Example of this Croſs, ſo the like may be performed for any Croſs of what length ſoever.

The Uſe of the Croſs-Staff.

To take a forward Obſervation of the Sun's Meridian Altitude at Sea.

When you do intend to take the Meridian Altitude at Sea, (in order to the obtaining of the Place's Latitude) it is convenient that you be preparing your ſelf for your Obſervation ſome competent time before Noon; and conſider what the Sun's greateſt Altitude may be that Day, accordingly to uſe thoſe Croſſes that may be moſt fit for your purpoſe.

As ſuppoſe the Meridian-Altitude for that Day be judged to be 20°, then uſe the Thirty-ſide of the Staff, and the thirty-Croſs; if you think it will be 30° or more, then take the Sixty-Croſs.

There is another requiſite fit to be underſtood before you proceed to Obſervation, and that is how to place your Fore-ſtaff to your Eye, to prevent an Error mentioned by Mr. *Wright*, in his *Correction of Errors*; to avoid which, take theſe few Hints.

Firſt, Place the Center of the Staff at A, to the out-ſide of the Corner of your Eye, as near your Eye as conveniently as you can, without hindring your Sight, letting the End reſt upon your Eye-bone, reſpecting as it were the Eye's Center, and cauſe the viſual Rays to concur with the middle Parallels drawn on each ſide of the Croſs-Staff, and then is your Staff rightly placed for Obſervation. But becauſe this is ſomewhat difficult plainly to be deſcribed, and perhaps that which is already ſaid may not be ſo obvious to the Reader as I could wiſh it, I will therefore give an eaſy Illuſtration, which may be verified by Experience.

Having firſt of all ſatisfied your ſelf in the truth of the Diviſions on the Staff, and likewiſe of the exact Length and Half-length of your Croſſes, then put on the Sixty-Croſs, and place it to 30° on his proper Side, and alſo ſlip on the Ninety-Croſs parallel with the former, and put that to 30° likewiſe on his peculiar Graduations; then bring the end of the Staff to the Corner of your Eye (as is directed) and remove it ſo that you ſee each end of the two Croſſes at once exactly to concur and agree with the viſual Lines proceeding from your Eye; that is the Place of your Staff in time of Obſervation, and may eaſily be found by frequent Trial.

Having thus prepared for your Obſervation, and acquainted your ſelf with the holding of your Inſtrument, being upon the Deck, turn your Face toward the Sun, and place your Staff to your Eye, holding the Croſs upright, look at the upper end of your Croſs, at C for the Sun, and at the lower at B for the Horizon: But if the Sea obſcure the Horizon from your Sight, then remove the Croſs a little further from your Eye: but if on the contrary, your Sight do not extend ſo low as the Horizon, but the Sky only appears in the ſtead thereof, then move the Croſs a little nearer your Eye, until by the upper part thereof you ſee the Center of the Sun, and by the lower the Horizon, exactly at the ſame time; then look upon the proper Side of the Staff (for the Croſs you uſe) the Sun's preſent Altitude will be cut by the ſame; and this, if it were for one ſingle Obſervation either of the Sun or any Star, were ſufficient.

But the Sun's greateſt Altitude being that you are to take, you muſt therefore wait (making Obſervation as your Judgment ſhall direct you) until the Sun be upon the Meridian, ſtill ſliding the Croſs nearer your Eye as the Sun riſes, until you perceive it to be at the higheſt; for ſo ſoon as the Sun is to the Weſtward of the Meridian, and falling, if you make Obſervation again, you will find the Sea to obſcure the Horizon from your Sight, and then in no caſe remove your Croſs, but let it remain fixed, and finiſh your Obſervation for that ſeaſon.

Then caſt your Eye upon that Side of the Staff belonging to the Croſs you uſe, the Degrees and Minutes cut thereby, and numbred with larger Figures, (decreaſing always from the Center of the Staff) give the Sun's Meridional Altitude, and the ſmall Figures underneath, the Complemnet of the Altitude, or the Zenith Diſtance.

In obſerving forward by the Croſs-Staff, 'tis uſual to have a piece of red Glaſs to defend the Sight from the Luſtre of the Sun in time of Obſervation.

[It would, in my Opinion, be better to have the Glaſs fitted in a piece of Braſs, and ſo to be put upon the end of any of the Croſſes, as occaſion requires. Thus much for a forward Obſervation.]

After the ſame manner you muſt obſerve the Altitude of the Stars.

To make a backward Obſervation of the Sun's Altitude by the Croſs-Staff.

Theſe Obſervations are frequent at Sea, eſpecially with the *Hollanders*; and to perform this, you muſt have a Horizon-Vane, the innerſide of which fits upon the Center of your Staff, or elſe a ſliding one, according to the *Dutch* Faſhion.

Likewiſe there is a Shoe of Braſs to fit on to the end of any of the Croſſes, whoſe Uſe is the ſame with the Horizon-Vane in the Quadrant.

Having a Staff thus fitted, place the Horizon-Vane upon the Center or Eye-end of your Staff, and put on a Croſs fitteſt for your purpoſe; fix the Braſs Shoe at the lower-end thereof, then turn your back to the Sun, and looking through the Sight (made by the Braſs Shoe) on the end of your Vane, elevate or depreſs the end of your Staff, until the Shadow made by the upper-end of the Croſs, fall upon the upper-part of the Sight in the Horizon-Vane; then look through that Sight for the Horizon: But if the Sea obſcure the Horizon from your Sight, then remove your Croſs a little nearer to the Horizon-Vane; but if on the contrary, your Sight doth not extend ſo low as the Horizon, but the Sky only appears inſtead thereof, then remove the Croſs further from the Horizon-Vane, till you ſee the Shadow fall upon its due place, and perceive the Horizon exactly at the ſame time, then have you the Sun's preſent Altitude.

If you obſerve for the Latitude, you muſt reiterate your Obſervation as before; and when you perceive the Sun to be paſt the Meridian, deſiſt, and concluding your Obſervation, account your Degrees and Minutes, either of the Altitude, or its Complement, as is before ſhewn.

To uſe the Staff in a backward Obſervation, after the *Dutch* Faſhion, there muſt be a Horizon-Vane fitted to ſlide evenly upon the Staff, and then all the variety from the former manner of Obſervation will be this:

Place any of your Croſſes that you intend to uſe upon the Center of the Staff, turning the Nut inward, then ſlide on your Horizon-Vane with the Nut inwards, and fix on the Braſs-Shoe to the lower-end of your Croſs: then proceed with your Obſervation, removing the Horizon-Vane, as before you did the Croſs; and the Degrees and Minutes cut by the edg of the Horizon-Vane, upon the ſide peculiar to the Croſs you uſe, is the Sun's Altitude, or Complement thereof, as you reckon it in the greater or leſſer Figures.

SECT. II.

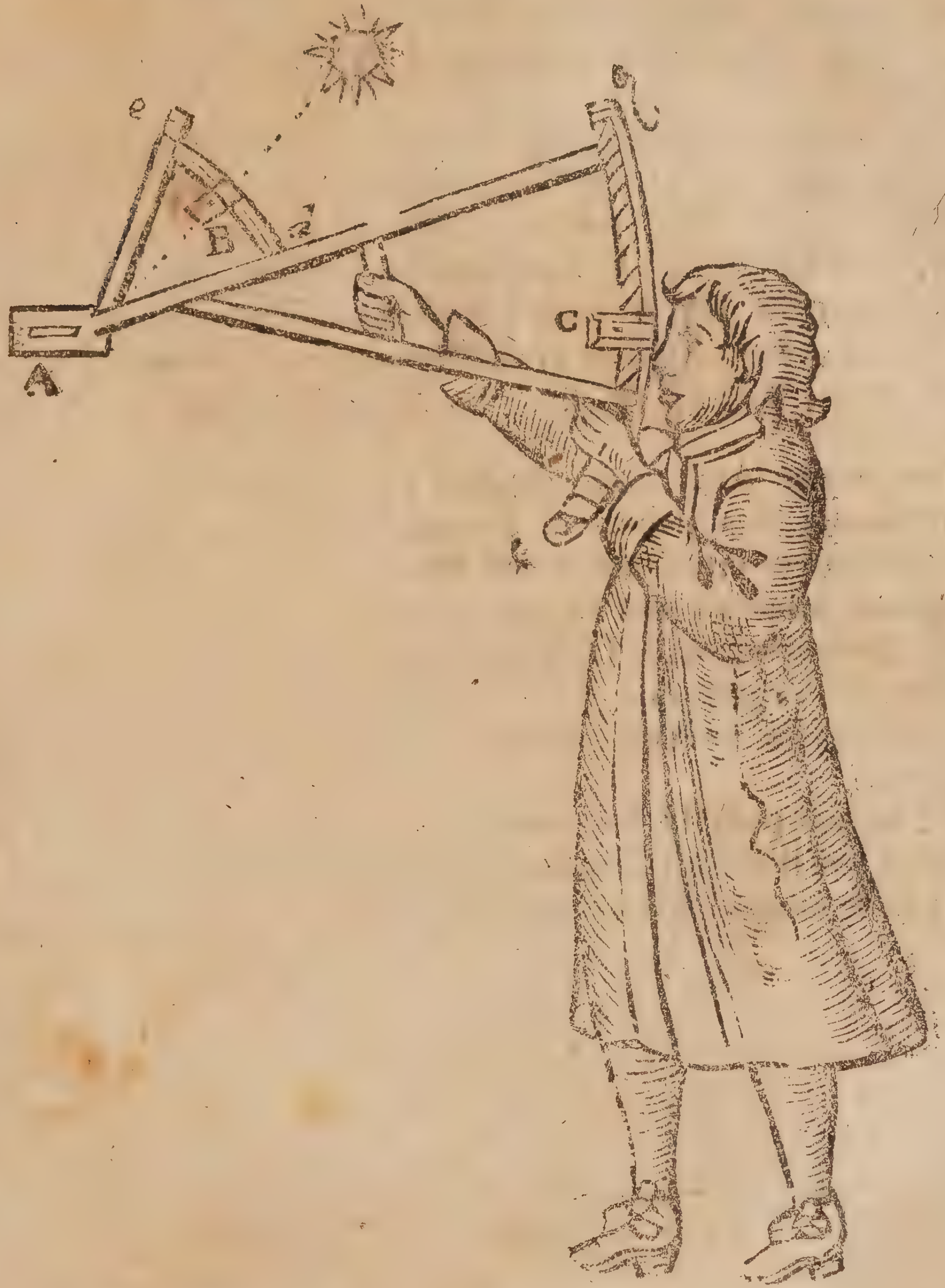
The Deſcription and Uſe of the QUADRANT.

THis *Quadrant* is of a very commodious Form and Contrivance, being at preſent the beſt approved, and moſt general Inſtrument that is in uſe, for obſerving the Sun's Meridian Altitude at Sea.

The Parts of this Inſtrument are principally three Vanes, and two Arches, which Arches together contain 90 Degrees, and give it therefore the Denomination of a *Quadrant*.

This Inſtrument is ſaid to be firſt contrived by Captain *Davis*, (that was employed in Queen *Elizabeth*'s time to diſcover the North-weſt Paſſage) and therefore called *Davis*'s *Quadrant*.

The Figure of the Quadrant, and Manner of Obſervation.



Of the three Vanes. That which in time of Obſervation reſpects the Horizon in this annexed Figure repreſented by A, is called the Horizon-Vane; that which gives the Shadow, noted by B, is named the Shadow-Vane; and that through which you are to look for both Shadow and Horizon, diſtinguiſhed with C, is called the Sight-Vane.

Of the Arches. The leſſer noted with *d e*, is named the Sixty-Arch, becauſe it uſually contains but 60°; it is of a ſmall Radius (adviſedly ſo contrived) for the more apt placing of the Vane B thereon, that the Shadow thereof falling upon the Horizon-Vane A, at this ſhort diſtance, might become the ſtronger, and the more perſpicuous to the Eye of the Obſerver.

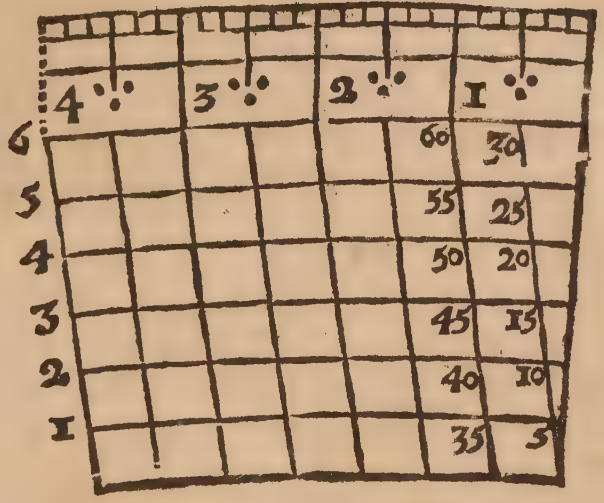
This Arch is commonly divided but to every Degree, and numbred from the upper end of the Arch downwards to the Line of Partition, (which is a Line drawn on the middle of the upper Leg of the Quadrant, between the two Arches) with 5, 10, 15, *&c.* And this is the Complement of the Altitude. Sometimes this Arch is figured with the Altitude, from the Line of Partition upwards towards the higher end of the Arch, with 5, 10, 15, *&c.* to 60; but this is not frequently uſed.

The greater Arch, here denoted by the Letters *f g*, is called the Thirty-Arch; this Arch is of a large Radius, the better to be divided and ſubdivided into Degrees and Minutes, the Limb whereof is of a competent breadth; and thereon are uſually deſcribed ſeveral concentrick Circles interſected with Diagonal Lines, for the more facile and exact dividing the Degrees into every fifth or every ſecond Minute; and hereby the Subdiviſions are conſpicuous, and may readily be computed by the Obſerver.

But becauſe poſſibly this manner of Diviſion may not be underſtood by every one that hath Occaſion for this Inſtrument, for their ſakes therefore I have annexed this following Figure.

The

The Figure of part of the Arch.



This Figure is part of the Limb of this Arch, as 'tis uſually drawn upon the Limb of the Quadrant, each Degree being ſubdivided into five Minutes: upon the Plain of this Arch are deſcribed ſix concentrick Circles, and are noted with the Figures 1, 2, 3, 4, 5, 6. And in the Limits of each Degree are drawn two Diagonals, interſecting theſe Circles; and thoſe Diagonals divide each Degree into two Parts, *viz.* into 30 Minutes; and the concentrick Circles ſubdivide each of theſe Diagonals, repreſenting 30 Minutes, into ſix other Parts, being five Minutes apiece: Therefore the firſt Interſection at 5, is five Minutes; the ſecond at 10, is ten Minutes; the third at 15, is fifteen Minutes; the fourth at 20, is twenty Minutes; the fifth at 25, is twenty five Minutes; the ſixth at 30, is thirty Minutes: the firſt again at 35, is thirty five Minutes; the ſecond at 40, is forty Minutes; at 45, is forty five Minutes; at 50, is fifty Minutes; at 55, is fifty five Minutes; and at 60, ſixty Minutes, or 1 Degree. And the like is to be underſtood of the reſt, always as they aſcend, encreaſing five Minutes.

And take this for a general Rule: Firſt count how many concentrick Circles there are, which are ſix or ten, and are to be computed as is here ſhewn, and noted by the Figures at the end of this Scheme: then ſee how many Diagonal Lines are drawn within the extent of each Degree, which are two or three; then multiply the Number of concentrick Circles, by the Number of Diagonals in one Degree, and by the Product divide 60, (the Minutes in a Degree) the Quotient ſhall give you the number of Minutes that each Interſection encreaſes by, and is more than the precedent. As ſuppoſe the concentrick Circles to be ten, the Diagonals in each Degree five; then multiply ten by three, the Product is 30, by which if you divide 60, the Quotient is 2: which ſhews that the Interſections encreaſe by two Minutes, the firſt repreſenting two Minutes, and ſo 4, 6, 8 Minutes, &c. to 58 and 60 Minutes, or 1°; and then 1° 2′, 1° 4′, 1° 6′, &c. And the like is to be underſtood of the reſt.

The Uſe of the Quadrant.

This Inſtrument is commonly uſed to obſerve the Sun's Meridian Altitude, which to perform we will briefly deſcribe.

Firſt, Put the Horizon-Vane on the end of the Quadrant on A, and then the Sight-Vane upon the Thirty-Arch in the precedent Figure; and laſtly, the upper-edg of the Shadow-Vane upon the Sixty-Arch, to a certain Number of Degrees moſt proper for your preſent Obſervation; which readily to perform, take this Caution.

Conſider what will be the Complement of the Meridian Altitude that Day, then place the Shadow Vane ſo, that the Degrees cut by the upper-edg of the Vane, be always leſs by 10 or 15° than you judg the Complement of the Sun's Meridian Altitude will be that Day in the place of Obſervation.

For inſtance; Suppoſe that the greateſt Altitude of the Sun for the time, in the Place of Obſervation, be eſtimated to be 45°, the Compl. is 45°; then place the Shadow-Vane at 30 or 35 deg. which are proper for your preſent Obſervation.

Having thus prepared your Inſtrument, and being ready upon the Deck, turn your back towards the Sun, and holding the Quadrant as upright as you can, place the Sight-Vane to your Eye, and looking through the Sight, bring the Shadow of the upper edg of the Shade-Vane to fall upon the upper part of the Slit, or open Sight in the Horizon-Vane, and at the ſame time look through the ſaid ſlit for the Horizon; and if the Sea obſcure the Horizon from your Sight, then ſlide your Sight-Vane a little lower down towards *f*; but if on the contrary your Sight doth not extend ſo low as the Horizon, but if the Sky only preſents it ſelf to your Eye, then remove your Sight-Vane a little higher towards *g*, then make Obſervation again, continuing to move your Sight-Vane higher or lower according to theſe Directions, until looking through the Sight-Vane, the Shadow fall upon its due Place, and that at the ſame time you exactly ſee the Horizon through the Sight in the Horizon-Vane, then have you the Sun's preſent Altitude. But it being the Meridian or greateſt Altitude that you are to obſerve, you muſt therefore continue to make Obſervations as often as you ſhall think fit, (but eſpecially you are to tend your Obſervation, when you perceive the Sun almoſt upon the Meridian) until the Sun be to the Weſtward of the Meridian, and is leſſening his Altitude; for then if you make Obſervation, the Sky will be ſeen, and not the Horizon; and in this Caſe you muſt not alter your Sight-Vane, but letting it ſtand, conclude your Obſervation for that ſeaſon; then caſt your Eye upon the Thirty-Arch, and ſee how many Degrees and Minutes are cut by the in-ſide of the Sight-Vane, and thereto add the Degrees at the upper-edg of your Shadow-Vane, the Sum is the Complement of the Altitude, or the Sun's Diſtance from the Zenith.

Note; The ſmall Arch in ſome Quadrants contains 70 Degrees, and the greater 20 Degrees, whoſe Sum is 90. Theſe Arches are numbred and divided like the former; and if that be well underſtood, this will not ſeem obſcure, and therefore it is needleſs to ſay any more of this Alteration.

And here note, That there is a late Contrivance with a ſmall Convex-Glaſs to be let into the Shadow-Vane, which may be uſed when the Sun is haſey, and will not ſtrike a clear Shadow upon the Shadow-Vane; then this Glaſs will contract the Beams of the Sun, and reflect a ſmall Speck of Light upon a ſmall black Line drawn on the Horizon-Vane, which reſpects the Center of the Sun. And further *note*, That in thoſe Obſervations made by the upper-edg of the Shadow-Vane, it is proper to ſubtract 16′, or ſomewhat leſs, from the Sun's Altitude, or add it to the Zenith Diſtance (for the Semi-diameter of the Sun); but in uſing the Glaſs you are not to make any ſuch Allowance, becauſe the Spot repreſents the Center of the Sun.

SECT. III.

Rules for finding the Latitude of the Place by Obſervation of the Sun's Meridian Altitude, or Zenith-Diſtance, by help of the Table of the Sun's Declination.

BEcauſe 'tis common to work the Obſervation of the Sun, taken by the Quadrant and other Inſtruments (now in uſe) by the Complement of the Meridian Altitude, or the Sun's Diſtance from the Zenith, I ſhall therefore give Rules, illuſtrated with Examples, for that purpoſe.

Rule 1.

If the Sun come to the Meridian in the South, and have South Declination, ſubtract the Declination from the Complement of the Meridian-Altitude, the Remainder is the Latitude of the Place of Obſervation Northerly : but if the Declination exceed the Zenith Diſtance, then ſubtract the Zenith Diſtance from the Declination, the Remainder is the Latitude Southerly.

Example 1.

Admit you are at Sea, and the Sun being upon the Meridian in the South, is 37° 30′ diſtant from the Zenith, and at the ſame time hath 12° 00′ South Declination : I demand the Latitude of the Place.

The Operation.

Complement of the Meridian-Altitude — 37° 30′
The Sun's Declination South, ſubtract — 12 00
The Latitude of the Place — 25 30 North.

Example 2.

Admit (being at Sea) the Sun being on the South-part of the Meridian, is 10° diſtant from the Zenith, and the Declination 20° 30′ South: I demand the Latitude of the Place.

The Operation.

The Sun's Declination —————— 20° 30′
The Diſtance from the Zenith ſubtract —— 10 00

The Latitude —————————— 10 30 South.

Rule 2.

If the Sun be upon the Meridian in the South, and hath North Declination, then add the Declination to the Zenith Diſtance, the Sum is the Latitude Northerly.

Example.

Admit a Ship at Sea, and the Sun on the South part of the Meridian is 30° 30′ from the Zenith, and the Declination is 15° 30′ North: I demand the Latitude.

The Operation.

The Compl. of the Altitude, or Zenith Diſtance, is 30° 30′
The Declination added ———————— 15 30

The Latitude —————————— 46 00 North.

Rule 3.

If the Sun be on the Meridian in the North, and have North Declination, then ſubtract the Zenith Diſtance from the Declination, the Remainder is the Latitude Northerly: But if the Zenith Diſtance exceeds the Declination, then ſubtract the Declination therefrom, the Remainder is the Latitude Southerly.

Example 1.

Suppoſe the Declination were 20° North, and the Zenith Diſtance 12° 30′, the Sun being upon the Meridian in the North: I demand the Latitude.

The Operation.

The Sun's Declination North———20° 00′
The Zenith Diſtance ſubtracted———12 30

The Latitude of the Place——— 07 30 North.

Example 2.

Suppoſe the Sun's Declination to be as before, 20° North, and that being upon the Meridian to the Northwards, his Zenith Diſtance is 40° 15′: I demand the Latitude.

The Operation.

The Zenith Diſtance of the Sun is———40° 15′
The Declination North ſubtract——— 20 00

The Latitude 20 15 South.

Rule 4.

If the Sun be upon the Meridian in the North, and hath South Declination, then add the Declination to the Zenith Diſtance, the Sum is the Latitude Southerly.

Example.

Admit the Sun's Declination were 16° 45′ South, and the Zenith Diſtance 29° 45′: I demand the Latitude.

The

The Operation.

The Declination of the Sun South ——— 16° 45'
The Zenith Diſtance add ——— 29 45

The Latitude ——— 46 30 South.

Rule 5.

If the Sun have no Declination, then the Complement of the Altitude is the Latitude of the Place; and if the Sun be on the Meridian in the South, your Latitude is Northerly; if in the North, Southerly. This needs no Example.

Rule 6.

If the Sun be in the Zenith, *i. e.* 90° above the Horizon, then the Declination either Northerly or Southerly, is the Latitude of the Place. This likewiſe needs no Illuſtration.

Rule 7.

If you be within the Artick or Antartick Circles, and obſerve the Sun upon the Meridian under the Pole, then add the Sun's Declination to the Complement of the Altitude, and ſubtract the Sum from 180°, the Remainder is the Elevation of the Pole.

Note.

If your Inſtrument wherewith you obſerve give only the Meridian Altitude, then ſubtract that Altitude from 90°, the Reſidue is the Zenith-Diſtance or Co-Altitude of the Sun; and the Operation is the ſame, as in the precedent Examples.

For the Stars.

What hath been here delivered in theſe Rules concerning the Sun's being upon the Meridian, the ſame is to be underſtood of any Star whoſe Declination is known.

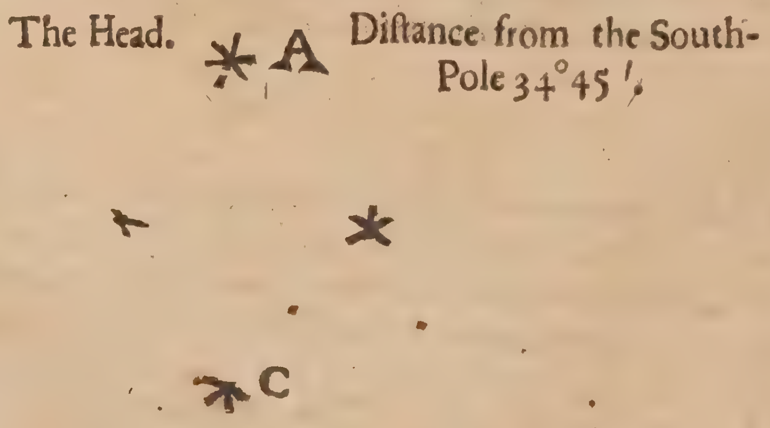
Admit you ſhould obſerve the bright Star *Arcturus*, woſe Declination is 20° 58′ North, when he is upon the Meridian in the South, and find his Altitude to be 65° 25′, the Compl. thereof 24° 35′ is the Zenith Diſtance; then adding 20° 58′ to 24° 35′, the Sum is 45° 33′, the Latitude Northerly, according to the ſecond Rule aforegoing.

But if you obſerve by any of the Stars near the North-Pole, whoſe Polar Diſtance is ſet down in the Tables of Declination; and if they be on the Meridian under the Pole, add the Complement of the Declination, or Polar Diſtance, to the Meridian Altitude found, the Sum is the Latitude Northerly.

But, *Secondly*, If you obſerve any Star that is upon the Meridian in the North, above the Pole, then from the Meridian-Altitude of that Star, ſubtract the Complement of the Declination, or Polar Diſtance, the Remainder is the Latitude Northerly: But if the Complement of the Star's Declination cannot be ſubtracted from his Meridian-Altitude, ſubtract the Meridian-Altitude therefrom, the Remainder is the Latitude Southerly. The ſame may be underſtood of Stars near the South-Pole.

Here I thought it neceſſary to mention ſomething of the *Croſiers*, which are certain Stars that are of good uſe in the Southern Navigation; they are ſo called, becauſe they do ſomewhat reſemble the Form of a Croſs, according to the annexed Figure.

The Figure of the Conſtellation called the Croſiers.



The *Cock's-Foot*, Diſtance from the South-Pole 28° 45′.

The Star at C, called the *Cock's-Foot*, or rather the *Croſs-Foot*, whoſe Declination, according to the Obſervation of Mr. *Edmond Haley* at St. *Hellena*, is 61° 15′ Southerly; and ſo the Complement of the Declination or Polar Diſtance, is 28° 45′. By this Polar Diſtance and the Meridian-Altitude of this Star, when he is either above or below the Pole, you may find the Latitude of the Place, by the Rules of the Stars laſt mentioned. The Polar Diſtance of the Head of the Croſs is 34° 45′.

To know when theſe Stars are fit for Obſervation, hold up a Thread and Plummet, and when the Thread cuts the Star at A and that at C both at the ſame time, then they are upon the Meridian, and fit to be obſerved.

SECT. V.

The Deſcription and Uſe of the Nocturnal.

THis Inſtrument conſiſts of three Parts:

Firſt, The broadeſt and greateſt, which we may call the unmoveable Part, which hath a Handle to hold it by in time of Obſervation.

Secondly, The firſt moveable, or middle Part.

Thirdly, The long Index, that is to turn to the Poſition of thoſe Stars for which they are made, *viz.* the Guards of the *Little* or *Great-Bear.*

The Fore-ſide of the firſt, or unmoveable Part, hath the Limb or outward Circle divided into twelve Months, and each Month ſubdivided into its reſpective Days, and are counted towards the left-hand, and marked with their Names, or the firſt Letter thereof, as *J* for *January*, *F* for *February*, *M* for *March*, &c. And upon ſome of them there are two other Circles, the outermoſt of which is divided into 24 equal Parts or Hours; and the other into 29 Parts and a half, or Days of the Moon's Age, by which the Moon's Southing may be known by Inſpection, and thereby a computation of the Tides.

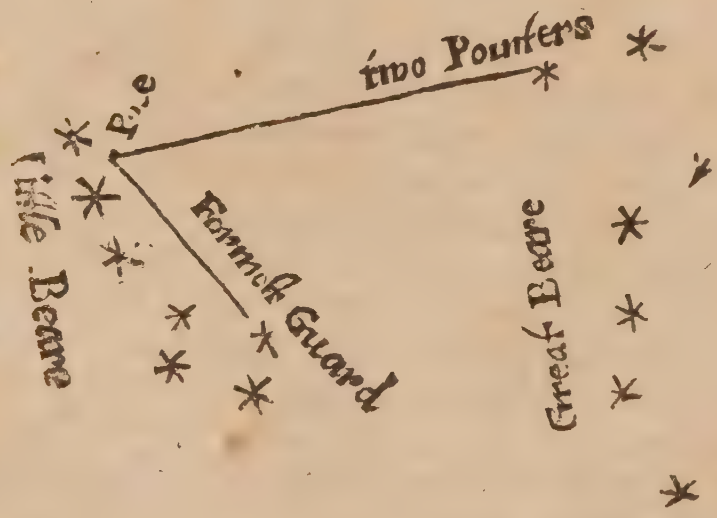
Of theſe *Nocturnals* there are two ſorts, one for the Guard of the *Little*, the other for the Guards of the *Great Bear*, or *Charles's Wain*, commonly called the two *Pointers*. Now to know for which of theſe Conſtellations any Nocturnal is made, you may obſerve, that the Nocturnals that are for the Guards of the *Great Bear*, have the 17*th* of *February* on the top; and if it be for the Guard of the *Little Bear*, then
you

you will find the 21*ſt* of *April* there. The Backſide of this part is divided into the 32 Points of the Compaſs, which are to ſhew the bearing of the Guards, thereby to know what Diſtance the North-Star hath upon any Point of the Compaſs.

The ſecond and moveable Part hath a Tooth proceeding from it, with the edg continued in a Right Line from the Center, which is to be turned to the Day of the Month at pleaſure; and on the Superficies thereof is a Circle divided into 24 equal Parts or Hours, which when the ſaid Tooth is ſet to the Day of the Month, and the Index turned to the Poſition of the Guards, the ſtreight Side of the Index will ſhew the Hour of the Night upon the ſaid Circle.

The third and upper moveable part is called the Index, having one ſide thereof proceeding from the Center, which is to be turned to the Guards in time of Obſervation; and through all theſe pieces in the Center of the Inſtrument is a Hole, through which you are to ſee the North-Star, and at the ſame time the Index is to be turned to the Guards.

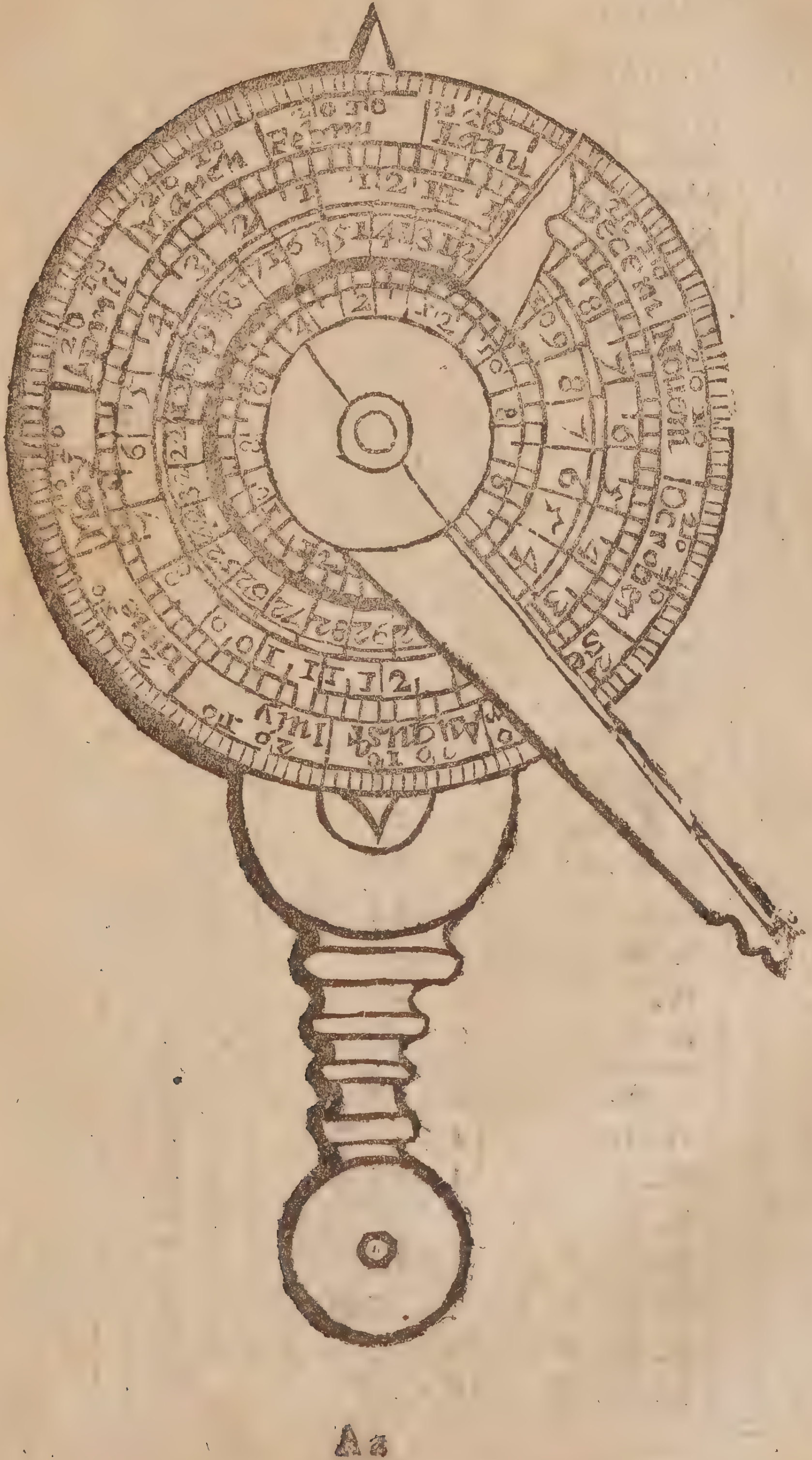
The Figures of the Stars, as they ſhew themſelves in the Heavens, for which the Nocturnals are made.



But if you would be better ſatisfied in the Forms of the Stars in each Conſtellation, I refer you to the new Hemiſpheres and Planiſphere of the Heavens, that are very uſeful for knowing the Stars; ſold by the Author.

The

The Figure of the Nocturnal:



Here followeth a Table for the Diſtance of the North Star, upon every Point of the Compaſs the Guards are upon, fitted for both ſorts of Nocturnals.

	Points of the Compaſs.	For the guard of the Little Bear.			For the guards of the Great Bear, or aftermoſt Wheels in *Charles's Wain*, called the two Pointers.			
		D.	M.			D.	M.	
If the former of the Guards be aſcending from the North, or lower part of the Meridian.	North.	2	09	The North Star is above the Pole.	If the after-Wheels, or two Pointers be aſcend. from the North, or lower part of the Merid.	2	20	Above the Pole.
	N. by E.	1	52			2	30	
	N. N. E.	1	29			2	35	
	N. E. by N.	1	04			2	33	
	North Eaſt.	0	35			2	26	
	N. E. by E.	0	06			2	13	
	E. North E.	0	20	The North Star is under the Pole.		1	55	
	E. by N.	0	50			1	33	
	Eaſt.	1	18			1	07	
	E. by S.	1	41			0	38	
	E. S. E.	2	01			0	08	The North Star is under the Pole.
	S. E. by E.	2	16			0	22	
	South Eaſt.	2	25			0	52	
	S. E. by S.	2	30			1	20	
	S. S. E.	2	29			1	44	
	S. by E.	2	22			2	04	
If the former of the Guards be deſcending from the South, or upper part of the Merid.	South.	2	09			2	20	
	S. by W.	1	52		If the two Pointers be deſcending from the South, or upper part of the Meridian.	2	30	
	S. S. W.	1	29			2	35	
	S. W. by S.	1	04			2	33	
	South Weſt.	0	35			2	26	
	S. W. by W.	0	06			2	13	
	W. S. W.	0	20			1	55	
	W. by S.	0	50			1	33	
	Weſt.	1	18	The North Star above the Pole.		1	07	
	W. by N.	1	41			0	38	
	W. N. W.	1	01			0	08	
	N. W. by W.	6	16			0	22	Above the Pole.
	North Weſt.	2	25			0	52	
	N. W. by N.	2	30			1	20	
	N. N. W.	2	29			1	44	
	N. by W.	2	22			2	04	

The Manner of holding the Nocturnal in time of Obſervation.

Take the Handle in your Hand, with the foreſide towards you, holding of it upright in your Hand, (which you may diſcern by the Tip that is on the very top of the Nocturnal) then looking through the Hole in the Center to the North Star, you muſt turn the upper edg of the Index (which cometh from the Center) to the Guards; this being underſtood, you may now proceed to the ſeveral Uſes thereof.

To find the Hour of the Night by the North-Star, and the Guards either of the Little or Great-Bear, and upon what Point of the Compaſs they are.

To perform this, you muſt firſt ſet the Index of the ſecond moveable Part to the Day of the Month, (then if it will not ſtay of it ſelf, you muſt ſtay it with your Thumb) holding it as you are before *directed*; find the North-Star through the Hole, and turn the Index to the Guards, and then upon the ſecond moveable Part, the edg of the Index ſhall cut the hour of the Night: At the ſame time you will find on the backſide what point of the Compaſs the Guards are upon, ſo that you may know alſo what Diſtance the North-Star hath at that time, either above or under the Pole.

To find the Time of the Moon's coming to South any Day of her Age, and alſo the Time of high Water that Day.

Firſt, find the Moon's Age on the moveable Part; and right againſt it, in the Circle of Hours, you will find the Time of the Moon's Southing.

Example.

Suppoſe the Moon were eight Days old, I demand the Time of her coming to South.

Therefore look for 8 on the Circle of her Age, and right againſt it you will find in the Hour-Circle, almoſt half an hour paſt ſix of the Clock in the Evening, (becauſe that always between the Change and the Full ſhe cometh to South in the Evening, but after the Full ſhe cometh to the South in the Morning:) So having found the Moon's Southing, if you add thereto the Hour of the flowing at any place, it will ſhew you the time of High-water that day.

Example.

Suppoſe that here at *London*, the Moon being 8 Days old, I find by the Nocturnal, that the Moon cometh to South at almoſt half an hour paſt ſix of the Clock; to which I add three Hours, the Time of High-water at the Full and Change, which makes 9 of the Clock and almoſt half an hour paſt, the Time of High-water at *London*-Bridg that Day of the Moon's Age.

And if thoſe Numbers being added together ſhould exceed 12, that 12 muſt be ſubtracted from it, and that will be the Time of Full-Sea.

As ſuppoſe the Moon ſhould be 13 Days old, at which time I find by the Nocturnal, that the Moon cometh to South at 10 of the Clock, and almoſt half an hour, unto which if you add 3, it maketh 13 Hours and an half; from which if you take 12, there remains 1 of the Clock, and almoſt half an hour, the Time of High-water at *London-Bridg*, according to the common Way of Computation.

And to know the Time of Full-Sea at any other Place, I refer you to the Tide-Tables, *Page* 272.

CHAP. XI.

Containing the Uſe of the Plain-Scale, Gunter's *Scale*, Sinical Quadrant, Plain Chart, Mercator's Chart, *of both* Globes; *and likewiſe the ſecret Properties of the* Load-Stone.

SECT. I.

The Deſcription and Uſe of the Plain-Scale.

THE uſe of this Inſtrument is facile and delightful, and ſerves the Conſtruction of Problems in *Navigation* and *Aſtronomy*.

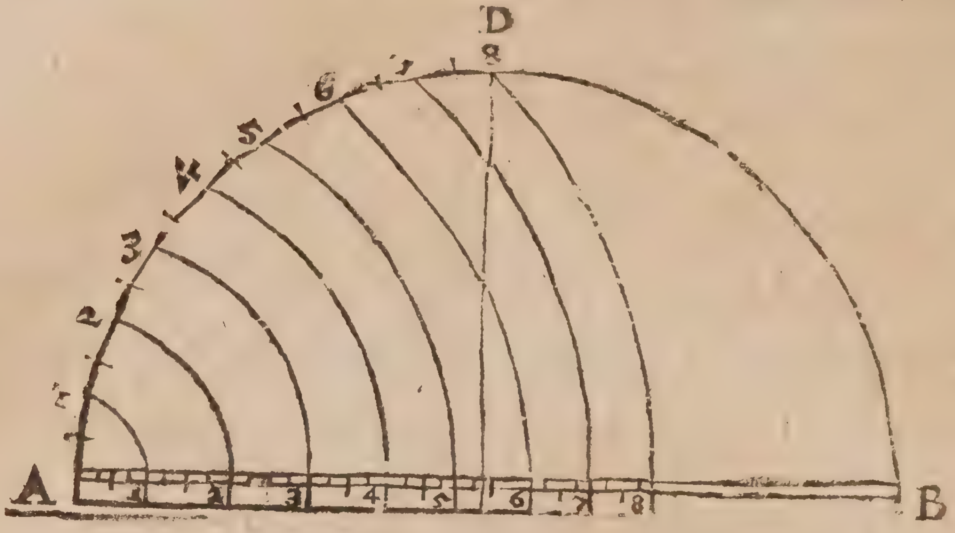
The Lines on a *Plain-Scale* are uſually a Line of equal Parts, Chords, Rhombs, and Longitude; but on this here deſcribed, is likewiſe a Line of Sines, Tangents and Secants.

Plate 6. Fig. 25.

We ſhall here inſert the Projection of theſe Lines on the Scale.

The

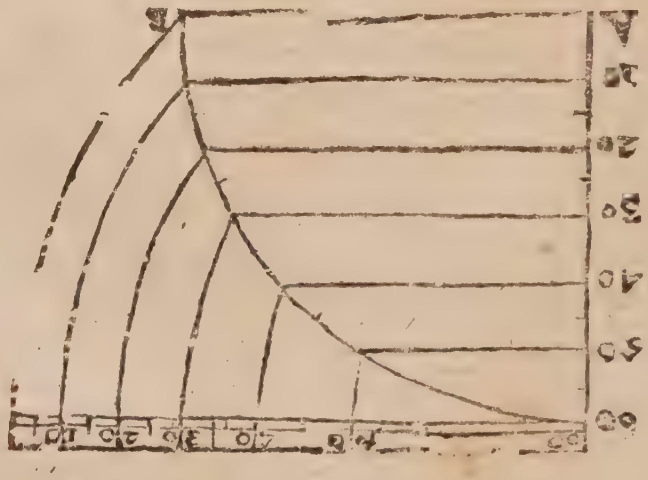
The Line of Rhombs.



The Projection of the Line of Rhombs.

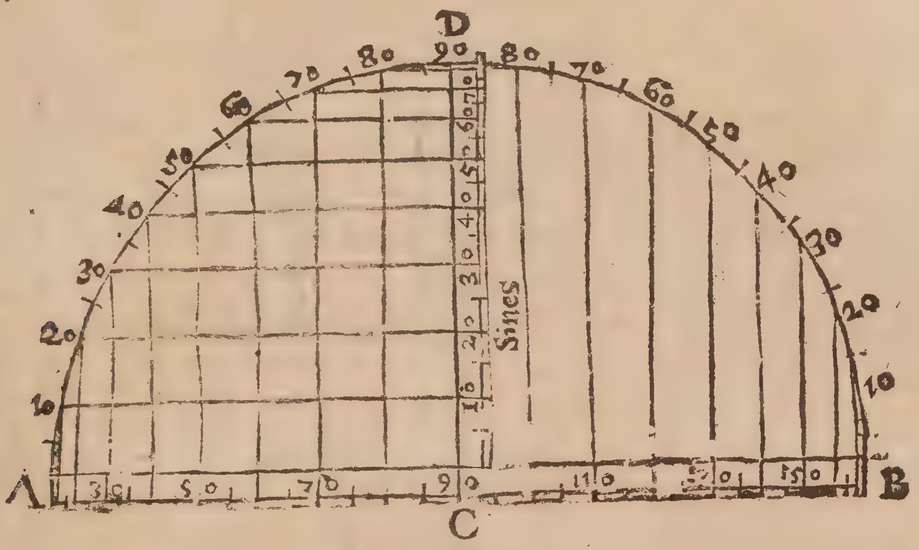
For the dividing of the Line of Rhombs, firſt draw the Line A C B, and upon the Point C deſcribe the Semi-Circle A D B, and divide the Quadrant A D into 8 equal parts: which being done, ſet one foot of your Compaſſes in the Point A, and with the other foot extend to each of thoſe Diviſions, and transfer thoſe Extents unto the Line A C B, which will divide the ſaid Line into 8 unequal parts, which will be a Line of Rhombs, and to be numbred with 1, 2, 3, 4, &c. unto 8: and ſo the Halves and Quarter-points of the Compaſs are to be inſerted.

The Line of Longitude.



The Projection of the Line of Longitude.

Firſt, draw the Quadrant C A B, and divide the Side C A into 60 equal parts; then through each of thoſe equal parts draw Lines parallel to the Side A B, until they touch the Quadrant C B; which being done, ſet one foot of your Compaſſes in the Point C, and extend the other foot unto each reſpective Point of Interſection in the Quadrant C B, and then transfer them to the Line C D (which is to be the Diſtance between C and B, or the Chord of 90 Degrees;) ſo ſhall thoſe Interſections divide the Line C D into 60 unequal parts, which is called the ***Line of Longitude.***



The Line of Sines.

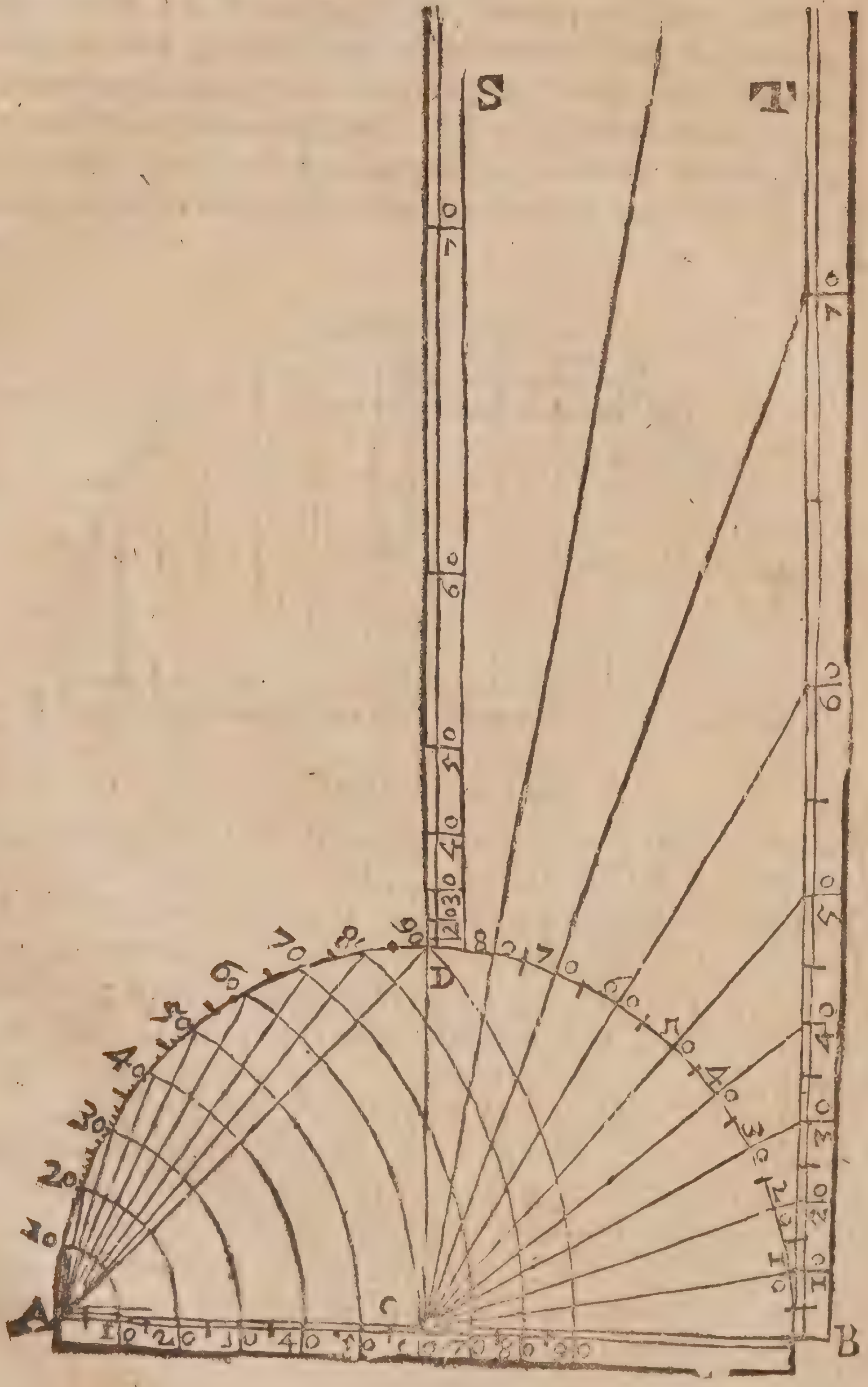
The Projection of the Line of Sines is thus to be performed; Firſt, draw the Line A C B, and upon C deſcribe a Semi-Circle, and one of the Quadrants divide into 90 Degrees, as the Quadrant A D C; then draw a Line through each tenth Degree of the Quadrant parallel to the Line A C B, it will divide the Line D C into 90 unequal parts, which will be a Line of Sines, to be numbred from C towards D, with 10, 20, 30, *&c.* unto 90.

The Line of Verſed Sines.

The Projection of the *Line of Verſed Sines*, is thus to be effected: Firſt, draw the Line A C B, and upon C draw the Semi-circle A D B, which divide into 180 Degrees; then through each deg. drawing Right Lines parallel to the Line D C, they will divide the Line A B into 180 unequal Parts, which will be a Line of verſed Sines, to be numbred with 10, 20, 30, 40, *&c.* unto 180.

The

The Line of Chords.



For the Projection and Diviſion of the Line of Chords, you muſt firſt draw the Diameter A C B in the foregoing Scheme, and upon the Center C deſcribe the Semi-circle A D B; which Semi-circle divide into two Quadrants by the Point D, then divide the Quadrant D A into 90 equal Parts or Degrees; this being done, ſet one Foot of your Compaſſes in the Point A, let the other be extended to each Degree of the Quadrant A D, which Extents transfer unto the Line A C B, as you may ſee the Arches lead in the foregoing Figure. This Line, ſo divided into ninety unequal Diviſions, is called a Line of Chords. After this manner you make it of what Radius you pleaſe, and number it with 10, 20, 30, *&c.*

The Line of Tangents.

Firſt draw the Quadrant, as in the foregoing Scheme, and divide it into 90 Degrees, and from the Point B erect a Perpendicular Line, as the innermoſt Line T B: then from the Center C draw Lines through each Degree of the Quadrant C D B, until they touch the Line T B, and thoſe Interſections will divide the Line T B into a Tangent, to be numbred with 10, 20, 30, *&c.*

The Line of Secants.

Having drawn thoſe Lines in the foregoing Scheme, through each reſpective Degree of the Quadrant, from the Center C, until they touch the Line T B, extend your Compaſſes from the Center C to the Extremity of each reſpective Line; and the Foot of the Compaſſes ſtill remaining in the Point C, transfer the ſaid Lines unto the Line C D S, ſo ſhall they divide the ſaid Line into unequal Parts, which is a Line of Secants, and number them with 10, 20, 30, *&c.*

Problems of Plain-Sailing by the Plain-Scale.

Problem I.

A Ship ſails N. E. by E. 108 *Leagues; I demand the Difference of Latitude and Departure.*

In the following *Problems of Plain Sailing*,

A C repreſents the *Diſtance ſailed*,
A B the *Difference of Latitude.*
B C the *Departure.*
B A C the *Courſe.*
A C B the *Complement of the Courſe.* *Plate 6. Fig. 26.*

Draw the occult Line A B, take off 60 from the Line of Chords, and ſweep the prick'd Arch d e. Set off the Courſe five Points, taken from the Line of Rhombs, from d to e; then draw the Line A e C, and ſet off 108 Leagues by the Line of equal Parts, from A to C; let fall the Perpendiclar B C, and ſo finiſh the Triangle A B C, in which you will find the Diff. Lat. A B 60 Leagues; the Departure B C 90 Leagues.

Problem II.

A Ship ſails N. E. by E. until her Difference of Latitude be 60 Leagues; I demand the Diſtance and Departure?

Plate 6. Fig. 26.

Draw A B of the given Length, and raiſe the occult Perpendicular B C, ſet off the Courſe five Points, as in the former Problem. Draw A C until it meet with B C, and finiſh the Triangle; the Diſtance is 108 Leagues, and the Departure 90 Leagues.

Problem III.

A Ship ſails N. E. by E. until her Departure be 90 Leagues; I demand the Diſtance and Difference of Latituae?

Plate 6. Fig. 27.

Draw the occult Line A B, and raiſe the Perpendicular B C of the given Length 90 Leagues; then upon the Point C ſweep the Arch d e with the Chord of 60°, and place the Complement of the Courſe three Points from d to e; then draw C e A until it meet with A B, and finiſh the Triangle. The Diſtance is 108 Leagues, the Difference of Latitude 60 Leagues.

Problem

Problem IV.

A Ship ſails between the North and the Eaſt 108 *Leagues, until the Difference of Latitude be* 60 *Leagues; I demand the Courſe and Departure?*

Plate 6. *Fig.* 28.

Draw A B 60 Leagues, and raiſe the occult Perpendicular B C, take off the Length of A C the Diſtance 108 Leagues, and placing one Point of your Compaſſes at A, deſcribe the occult Arch, cutting the Line B C at the Point C, by which draw A C, and finiſh the Triangle; the Departure B C is 90 Leagues; with a Chord of 60° ſweep the Arch d e, which meaſured upon the Line of Rhombs, will be found five Points, the Courſe ſought.

Problem V.

A Ship ſails between the North and the Eaſt 108 *Leagues, until her Departure be* 90 *Leagues; I demand the Courſe and Difference of Latitude?*

Plate 6. *Fig.* 28.

Draw the occult Line A B, and raiſe the Perpendicular B C of the given Length 90 Leagues: take A C 108 Leagues, and ſetting one Point of the Compaſſes at C, deſcribe the occult Arch, cutting the Line A B at A, by which draw A C, and finiſh the Triangle. The Courſe is found five Points, meaſured as in the former Problem, the Difference of Latitude 60 Leagues.

Problem VI.

A Ship ſails between the North and Eaſt, until the Difference of Latitude be 60 *Leagues, and the Departure* 90 *Leagues; I demand the Courſe and Diſtance?*

Plate 6. *Fig.* 28.

Draw A B 60 Leagues, raiſe the Perpendicular B C 90 Leagues, and by the Points A and C draw A C, and finiſh the Triangle. The Courſe is found 5 Points, as in the fourth Problem, the Diſtance 108 Leagues.

Problem VII.

There are two Ports that bear S. W. by S. and N. E. by N. diſtant 40 Leagues; A Ship ſails from the Northermoſt of them, firſt South, and then Weſt by South, ſometimes upon one of thoſe Courſes, ſometimes upon the other, until ſhe arrive at the Southermoſt Port; I demand how many Leagues ſhe hath ſailed upon one Courſe, and how many upon the other?

Plate 6. Fig. 29.

Let A repreſent the Northermoſt Port, and E the Southermoſt, A E their Diſtance, A D the Diſtance ſailed upon the South Courſe, D E the Diſtance upon the W. by S. Courſe.

Draw the Line A E 40 Leagues, being a N. E. by N. and a S. W. by S. Line; Deſcribe the Arch f g, ſetting off three Points, and draw the occult Line A D, being a South Line; then ſweep the Arch h l, and ſet off four Points, drawing the occult Line D E, until it meet with A D, and ſo finiſh the Triangle A D E. The Diſtance ſailed South is 29 Leagues, and W. by S. is 22 $\frac{1}{2}$ Leagues.

Problem VIII.

There are two Iſlands that bear Eaſt and Weſt, and are diſtant 40 Leagues; A Ship ſails from the Weſtward N. E. by E. and then ſailing 22 Leagues and a half further, arrives at the Eaſtermoſt Port; I demand the Diſtance ſailed upon the firſt Courſe, and what was the ſecond Courſe?

Plate 6. Fig. 29.

Let A repreſent the Weſtermoſt Port, E the Eaſtermoſt, D the Place where the Ship altered her Courſe, making the beſt of her way; A D the N. E. by E. Courſe; D E the other Courſe unknown: Draw A E 40 Leagues, ſet off an Angle of three Points, and draw A D, the N. E. by E. Line occultly; take the Diſtance 22 Leagues and a half, and placing one Point of your Compaſſes in the Point E, croſs the Line A D in the Point D, draw D E, and finiſh the Triangle. The Diſtance upon the firſt Courſe is 29 Leagues, the Angle at E is four Points, therefore the ſecond Courſe is S. E.

Problem IX.

Two Ships ſail from the ſame Iſland, the firſt ſails N. W. by N. 22 Leagues and a half, the ſecond W. by N. 40 Leagues, and arrive at their ſeveral Ports; I demand the Bearing and Diſtance of thoſe Ports.

Plate 6. Fig. 29.

E repreſents the Iſland, D the Northermoſt Port, A the Weſtermoſt.

Draw A E 40 Leagues, and ſet off the Angle at E four Points, and draw D E 22 Leagues and a half; then by the Points D and A draw A D, and finiſh the Triangle. The Angle at A is three Points, which ſhews the Bearing of the Ports to be E. N. E. and W. S. W. and the Diſtance A D almoſt 29 Leagues.

Problem X.

A Ship ſails from a certain Port W. N. W. 22 Leagues and a half, and then more Southerly 29 Leagues, and ſhe is forced back again to the Port from whence ſhe came 40 Leagues; I demand her Courſe from the ſecond Place to the third, and how ſhe ſteer'd back again?

Plate 6. Fig. 29.

E repreſents the firſt Port, D the Place where the Ship altered her Courſe, A the Place where ſhe was driven back.

Draw the Line D E 22 Leagues and a half, take the Diſtance A D 29 Leagues, placing your Compaſſes in D, deſcribe the occult Arch at A, and take the Diſtance A E 40 Leagues; deſcribe another occult Arch from E, croſſing the former in the Point A; draw A E and A D, and finiſh the Triangle. The Arch m n is 9 Points, therefore the Courſe from the ſecond Place to the third, is S. W. by S. and ſhe ſteered back again to the firſt Port E. N. E.

Here follow ſome *Problems* of *Mercator*'s *Sailing*, wrought two ways.

Firſt, By the *Plain Scale* only, by taking the middle Latitude, which is not exactly true, but may ſerve as an Approximation in a ſingle Courſe, provided the Diſtance be but ſmall, otherwiſe 'tis too groſs.

The *ſecond* way is by the *Meridional Parts*, which will be exact according to the Capacity of the Inſtrument.

The Uſe of the Plain Scale in Mercator's *Sailing by the middle Latitude.*

Problem I.

A Ship being in the Latitude of 40°, *ſails a N. Weſterly Courſe, until ſhe come into the Lat.* 45° 30′, *the Difference of Longitude* 90 *Leagues; I demand the Courſe, Diſtance, and Departure?*

Plate 7. *Fig.* 30.

For the Solution hereof by the *Plain Scale*, firſt draw the Line A C B, and upon the Center C deſcribe the Semi-circle A D B, and croſs the Line A C B at Right-Angles with the Line E C D; then find the middle Latitude, by taking the half-Sum of both Latitudes added together, which you will find to be 42° 45′, which middle Latitude ſet off from D to M and L both ways, and draw the Line M L; then ſet the Diſtance D F from B to G, then ſet off the Difference of Latitude 110 Leagues from B to H, and from G to A, and upon the Point A erect a Perpendicular, as A K, and from A ſet off the Difference of Longitude in Leagues, which is 90; from the Point K draw the Line K G, then from the Point H erect an occult Perpendicular, as the Line H I; then laying a Ruler from the Point B to the Point E (where the Line B K doth cut the Line E C) and draw the Line B I; then upon the Point B deſcribe the occult Arch C n, which being meaſured on the Line of Chords, will be found to be 31, or two Points three Quarters, which is the Courſe required, N. N. W. three Quarters Weſterly: and the Line B I is the Diſtance required, which being meaſured upon the Line of Leagues, will be found to be 129 Leagues, and the Departure H I 66 Leagues.

Problem II.

A Ship being in the Latitude 40° *North, ſails N. N. W.* ¾ *(or* 7° *Weſterly) until ſhe come into the Latitude of* 45° 30′; *I demand the Diſtance run, the Difference of Longitude, and the Departure?*

Plate 7. *Fig.* 30.

In the Solution of this *Problem* by the *Plain Scale*, draw the Line A B at any convenient Length, and upon C deſcribe the Semi-circle A D B,

Plate VI

Fig: 26

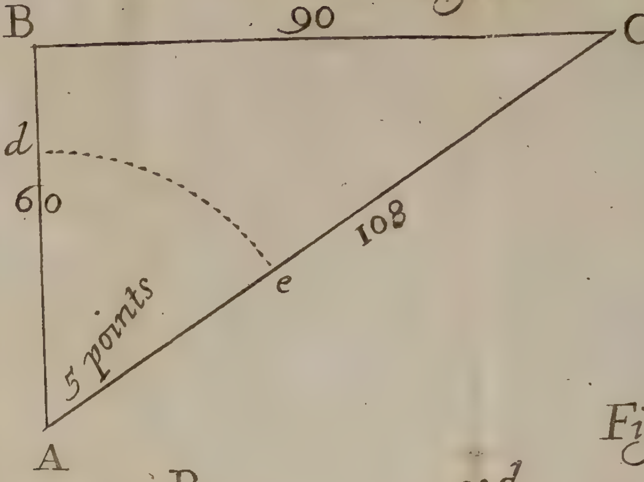


Fig: 27

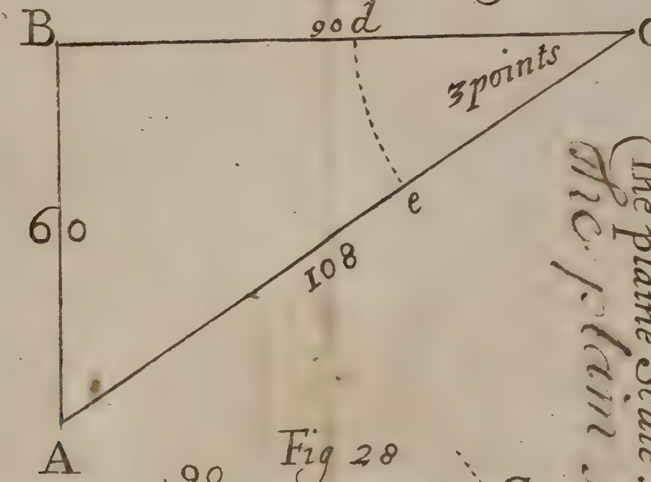


Fig 28

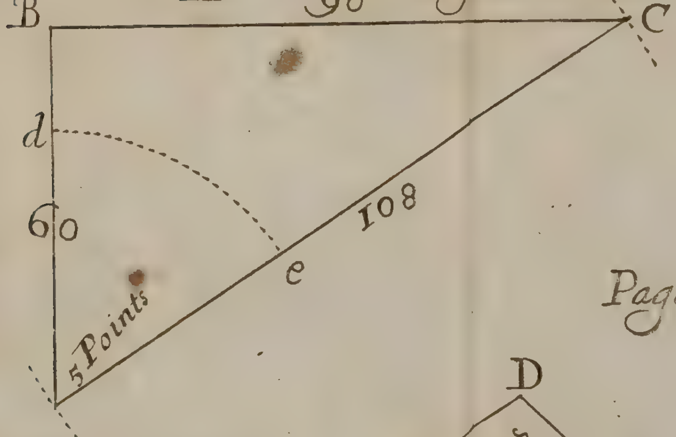


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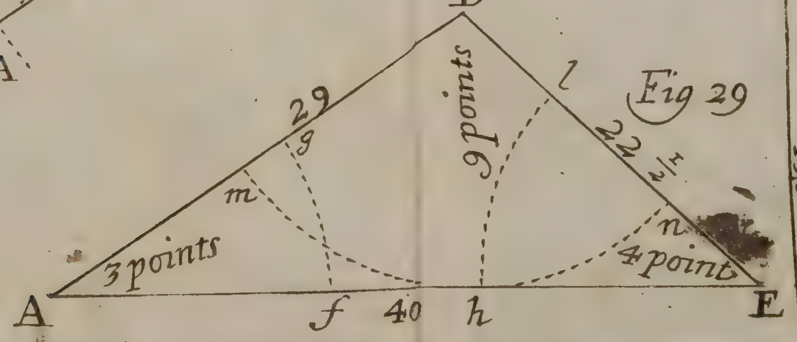
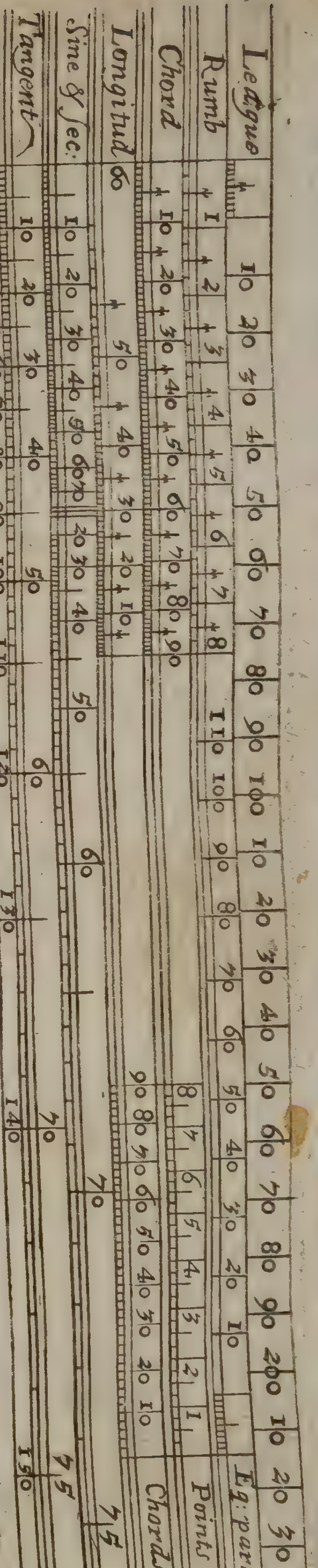
Fig 29





The plaine Scale.

The plain Scale

and find the middle Latitude as before, and ſet it off from D to M and L, and draw the Line M L, and upon the Point B deſcribe the obſcure Arch C n, and ſet off the Courſe given, (which is two Points three Quarters, or 31° and a Quarter) from C to n, and ſet the Diſtance C F from C to G, and from B ſet off the Difference of Latitude 110 Leagues, and the ſame Diſtance from G to A, and from the Points H and A erect the two Perpendiculars H I and A K; then through the Point n, draw the Line B I, which being meaſured in the Scale of Leagues, will be found to be 129; then laying a Ruler from G to the Interſection of the Lines at E, draw the Line G K, and note where it interſecteth the Line A K, which is at K: So the Diſtance A K being meaſured upon the Scale of Leagues, will be found to be 90 Leagues, the Difference of Longitude ſought, and H I the Departure 66 Leagues.

Problem III.

A Ship being in the Latitude 40° North, ſails between the North and the Weſt, until ſhe arrive to the Latitude 45° 30′, and that her Diſtance run be 129 Leagues; I demand the Courſe, Difference of Longitude, and Departure?

Plate 7. Fig. 30.

For the Solution of this Problem, firſt draw the Line A C B at any convenient Length; and upon C deſcribe the Semi-circle A D B, and ſet off the middle Latitude as before, and likewiſe the Diſtance C F from C to G, alſo the Difference of Latitude in Leagues from B to H, and from G to A; then erect the two Perpendiculars at H and A, then take the Diſtance betwen the Compaſſes, and ſet one Foot of the Compaſſes in B, and extend the other Foot towards I, until it doth interſect the Perpendicular at H in the Point I, and draw B I; then laying a Ruler upon the Point G, unto the Interſection of the Lines at E, draw the Line G K, and note where it doth interſect the Perpendicular at A, which will be at K; then the Diſtance K A being meaſured on the Scale of Leagues, will be found to be 90, the Difference of Longitude ſought. Then for finding of the Courſe, with the Radius of your Scale draw the obſcure Arch C n, and that being meaſured on the Line of Chords, will be found to be 31°. or two Points three Quarters, the Courſe required, which is N. N. W. three Quarters Weſterly, and the Departure H I 66 Leagues.

Problem IV.

A Ship being in the Latitude 40° North, ſails N.N.W. ¾ (or 7°) W. 129 Leagues; I demand the Latitude of the ſecond Place, the Difference of Longitude, and the Departure?

Plate 7. Fig. 30.

For the Solution of this Problem, firſt draw the Line B A of any convenient Length; then from one end thereof, as B, deſcribe the occult Arch C n, and ſet off 31°, or two Points three Quarters from C to n; then by the Point n draw the Line B I, the Diſtance 129 Leagues, and from the end thereof, as at I, let fall the Perpendicular I H: then meaſure the Diſtance H B, which you will find to be 110 Leagues, or 5° 30′; the Latitude of the ſecond Place is 45° 30′. Then having the two Latitudes, find the middle Latitude, as is before directed; then upon the Line B A, and upon the Center C, deſcribe the Semicircle B D A, and drawing the Line D E from the Point D, ſet off the middle Latitude 42° 45′ both ways, to M and L, and draw the Line M L; then take the Diſtance D F in your Compaſſes, and ſet it off from B to G, and from H to A; then upon the Point A erect an occult Perpendicular, as M K; then by the Point E, draw the Line G K, till it interſect the Perpendicular at K; then draw A K, which being meaſured in the Line of Leagues, will be found to be 90 Leagues, or 4° 30′, the Difference of Longitude, and H I the Departure 67 Leagues.

Problem V.

A Ship being in the Latitude 40°, ſails in that Parallel, until her Difference of Longitude be 6°; I demand her Diſtance run?

This Queſtion is uſually demonſtrated among the Problems of *Mercator's Sailing*, by a Scheme drawn for that purpoſe, differing from that already deſcribed; but we ſhall here ſhew the way how to reſolve this Problem by the Line of Longitude on the *Plain Scale.*

It is to be underſtood, that, according to the Globe, the Meridians do encline nearer together, until they concur and interſect each other in the Poles, ſo that thereby the Degrees of Longitude are not 60 of the Equinoctial Minutes in any Parallel on the North or South ſide of the Equinoctial; but the nearer to either of the Poles you approach, the more they decreaſe; ſo that in the Latitude of 60 deg. there are but 30 min. of the Equinoctial to one Degree of Longitude; and in the Latitude of 84 Degrees, there are but 6 Minutes, which doth ſhew the Errors of the *Plain Chart*: And therefore in ſailing, it ought to be rectified according to the Globe, and to that end was this Line of Longitude contrived, which is thus to be uſed.

If you deſire to know how many Minutes there are in a Degree of Longitude in any Latitude, you muſt extend the Compaſſes from the Center in the Line of Chords, to the Degrees of the Latitude of the Place, and the ſame Extent will reach from the Center at 60 on the Line of Longitude, to the number of Minutes anſwering to a Degree of Longitude in that Latitude.

Therefore for the Solution of the fifth Problem here propoſed, extend your Compaſſes upon the Line of Chords, from the Center to the Latitude of the Place, which is 40°, and the ſame Extent will reach from the Center at 60, in the Line of Longitude, to 46, which ſhews that 46′ make a Degree of Longitude in that Latitude; which 46 being multiplied by 6 the Degrees of Longitude, gives 276′, the Diſtance run, which was required.

Problem VI.

A Ship being in the Latitude of 40°, *ſails in that Parallel* 276′; *I demand her Difference of Longitude?*

For the Solution of this Problem, find how many Minutes make a Degree of Longitude in the Latitude of 40°, (as in the laſt Problem) which is 46; therefore if you divide 272 (the Diſtance run) by 46 (the Miles in a Degree of Longitude in that Latitude) the Quotient will be 6°, the Difference of Longitude required.

Another Way to work Mercator's *Sailing by the Plain Scale, and the Meridional Parts.*

Problem I.

A Ship ſails N. N. W. from the Latitude 40° *North, to the Latitude* 42° 20′ *North; I demand the Diſtance ſailed, the Departure, and Difference of Longitude?*

Plate 7. *Fig.* 31.

Having the two Latitudes 40° North, and 42° 20′ North, find the *Meridional Difference of Latitude* by the Table of *Meridional Parts,* which is 186′, and ſubtracting the one Latitude from the other, the Difference is 2° 20′, or 140′.

To work this Problem, draw the Line A b B; then place 140 from A to b, and 186 from A to B; raiſe the two occult Perpendiculars, b c and B C, ſet off the Courſe two Points, and draw the Line A c C, producing it until it cut both the Perpendiculars in the Points c and C, and ſo finiſh the two Triangles A b c and A B C. The Diſtance A c is 152′, the Departure b c 58, and the Difference of Longitude B C 77′.

Problem II.

A Ship ſails from the Latitude 40° *N. to the Latitude* 42° 20′ *N. until her Difference of Longitude be* 77′ *Weſterly; I demand the Courſe, Diſtance, and Departure?*

Plate 7. *Fig.* 31.

The Meridional Difference of Latitude is, as in the firſt Problem, 186′, the proper Difference of Latitude 140′.

Draw A B 186′, place 140′ from A to b, raiſe the Perpendicular B C of his given Length 77′, and alſo the occult Perpendicular b c; by the Points A and C draw A C, and finiſh the two Triangles. The Courſe, the Angle at A, is two Points, or N. N. W. the Diſtance A c 152′, the Departure 58′.

Problem III.

A Ship ſails Weſterly 152′ from the Latitude 40° North, to the Latitude 42° 20′ North; I demand the Courſe, Departure, and Difference of Longitude?

Plate 7. Fig. 31.

The *Meridional Difference of Latitude* is 186 Minutes, the proper *Diff. Lat.* 140 Minutes.

Draw A B 186′, and A b 140′, as before, and raiſe the two occult Perpendiculars b c and B C; take the Diſtance 152′, and placing one Point of your Compaſſes in the Point A, croſs the occult Line b c in the Point c, and draw A c, producing it until it concur with B C, and finiſh the Triangles. The Courſe is two Points, or N. N. W. the Departure 58′, the Difference of Longitude 77′.

Problem IV.

A Ship ſails N. N.W. 152′, from the Latitude 40° North; I demand the Latitude, Departure and Difference of Longitude?

Plate 7. Fig. 31.

Draw the occult Line A B, and ſet off the Courſe two Points, and the Diſtance A c 151′; let fall the Perpendicular b c, and ſo finiſh the Triangle A b c. Then A b will be found 140′, or 2° 20′, which makes the other Latitude 42° 20′, by which you will find the *Merid. Parts* to be 186′. Place 186′ from A to B, and raiſe the occult Perpendicular B C, until it meet with A c C continued, and ſo finiſh the Triangle A B C. The Departure b c is 58 min. The Difference of Longitude B C 77 min.

Problems of Great-Circle Sailing.

Problem I.

Two Places both in one Latitude, the Difference of Longitude being given; to find by what Latitudes and Longitudes the Arch paſſes, and the Courſes and Diſtances from Place to Place, in the Arch of a Great-Circle.

Example.

Suppoſe the *Lizard* and *Penguin*-Iſland on *New-found-Land*, both in the Latitude 50° North, the Difference of Longitude between them 47°; I demand by what Latitudes and Longitudes the Arch paſſes, and the Courſes and Diſtances from Place to Place?

Plate 7. Fig. 32.

Draw the Line A E, and place the Tangent of 40° the Complement of the Latitude from A to B; with 60° of the Chords ſweep the Arch D E, and ſet off 47°, the Difference of Longitude from E to D, and draw the Line A D, and place the Tangent 40°, the Complement of the Latitude from A to C; then draw the Line B C upon the Arch D E, ſet off every 5° from E to D, and draw the prick'd Lines, A b, A e, A d, *&c.* and where theſe Lines interſect B C, place the Letters, b, e, d, f, g, *&c.* The Diſtances, A b, A e, A d, *&c.* being meaſured on the Line of Tangents, are Tangents Complement of the Latitude, as follow.

Compl.	*Latit.*		*The Latitudes.*
A b	39	Therefore the *Latit.* are,	51
A e	38 $\frac{1}{2}$		51 $\frac{1}{2}$
A d	38		52
A f	37 $\frac{1}{2}$		52 $\frac{1}{2}$
A g	37 $\frac{1}{2}$		52 $\frac{1}{2}$
A n	37 $\frac{3}{4}$		52 $\frac{1}{4}$
A o	38		52
A u	38 $\frac{3}{4}$		51 $\frac{1}{4}$
A i	39 $\frac{1}{2}$		50 $\frac{1}{2}$

Theſe are the Latitudes by which the Arch paſſes at every 5° of Long. from B repreſenting the *Lizard*, to C which repreſents the *Iſland*.

Having theſe Latitudes and Longitudes, you may find the Courſe and Diſtance from Place to Place, according to *Mercator*'s *Sailing*.

A c is the Tangent Compl. of the greateſt Latitude by which the Arch paſſes, 52° $\frac{1}{2}$.

So the Latitudes and Longitudes of the ſeveral Points, b, e, d, *&c.* are as follow; likewiſe the Courſes and Diſtances from Place to Place.

D. Long.

D.Long.		Lat.	Places.	Courſes.	Diſt.
B	0°	50°			
b	5	51	From B to b	W.N.W.$\frac{1}{2}$ W.	208
e	10	$51\frac{1}{2}$	—— b to e	W.N.W.$\frac{1}{4}$ W.	206
d	15	52	—— e to d	W.N.W.$\frac{1}{4}$ W.	206
f	20	$52\frac{1}{2}$	—— d to f	W.N.W.$\frac{1}{4}$ W.	206
g	25	$52\frac{1}{2}$	—— f to g	W.	182
n	30	$52\frac{1}{4}$	—— g to n	W. by S. $\frac{1}{2}$ W.	154
o	35	52	—— n to o	W. by S. $\frac{1}{2}$ W.	154
u	40	$51\frac{1}{4}$	—— o to u	W.S.W. $\frac{3}{4}$ W.	186
i	45	$50\frac{1}{2}$	—— u to i	W.S.W. $\frac{3}{4}$ W.	186
C	47	50	—— i to C	W. S. W.	79

Problem II.

Two Places differing both in Latitude and Longitude, to find the Lat. and Long. by which the Arch paſſes, and the Courſes and Diſtances from Place to Place.

Example.

Suppoſe the two Places to be *Trinity-Harbour* in *Virginia*, in the Latitude 36° North, and the *Lizard* in the Latitude 50° North, the Difference of Longitude between them 68 deg. I demand by what Latitudes and Longitudes the Arch paſſes, and likewiſe the Courſes and Diſtances from Place to Place.

Plate 7. *Fig.* 33.

Draw the Line A F, place the Tangent of 40°, the Complement of the *Lizard*'s Latitude, from A to C; with 60° of the Chords deſcribe the Arch E F, placing 68 deg. from F to E, drawing the Line A E; then place the Tangent 54 deg. the Complement of *Trinity-Harbour*'s Latitude from A to B, and draw B C, letting fall the Perpendicular A d; then ſet off every 5 deg. from E towards F, (becauſe we ſail from B) draw the prickt Lines, A 1, A 2, *&c.* the Diſtance, A 1, A 2, A 3, *&c.* meaſured on the Line of Tangents, gives the Complements of the Latitudes by which the Arch paſſes at every 5° Difference of Longitude from B, repreſenting *Trinity-Harbour*, towards C, which is the *Lizard.*

The Diſtances A 1, A 2, A 3, *&c.* are as follow.

Diſt.	*Deg.*
A 1	51
A 2	$48\frac{1}{2}$
A 3	$46\frac{1}{4}$
A 4	$42\frac{1}{2}$
A 5	43
A 6	$41\frac{3}{4}$
A 7	$40\frac{3}{4}$
A 8	40
A 9	$39\frac{1}{2}$
A 10	$39\frac{1}{4}$
A 11	39
A 12	$39\frac{1}{2}$
A 13	$39\frac{3}{4}$

Therefore the Latitudes and Longitudes by which the Arch paſſes, are as follow.

	Long.	*Latit.*
B	00	36
1	05	39
2	10	$41\frac{1}{2}$
3	15	$43\frac{3}{4}$
4	20	$45\frac{1}{2}$
5	25	47
6	30	$48\frac{1}{4}$
7	35	$49\frac{1}{4}$
8	40	50
9	45	$50\frac{1}{2}$
10	50	$50\frac{3}{4}$
11	55	51
12	60	$50\frac{3}{4}$
13	65	$50\frac{1}{4}$
C	68	50

Having the Latitudes *and* Longitudes *by which the Arch paſſes, you may find the* Courſes *and* Diſtances *from Place to Place, by* Mercator's Sailing, *as in the Problem afore-going.*

The Courſes and Diſtances from Place to Place, wrought by Mercator, *are as follow in the Table.*

Places.	*Courſes.*	*Diſtances.*
From B to 1	N. E. ¾ E.	303
From 1 to 2	N. E. by E.	271
From 2 to 3	N. E. by E. ¼ E	264
From 3 to 4	N. E. by E. ¾ E.	247
From 4 to 5	E. N. E.	236
From 5 to 6	E. N. E. ¼ E.	226
From 6 to 7	E. N. E. ½ E.	208
From 7 to 8	E. N. E. ¾ E.	187
From 8 to 9	E. by N. ¼ E.	200
From 9 to 10	E. by N. ½ E.	154
From 10 to 11	E. by N. ½ E.	154
From 11 to 12	E. by S. ½ E.	154
From 12 to 13	E. by S. ¼ E.	200
From 13 to C	E. by S.	77

Aſtro-

Aſtronomical Problems wrought by the Plain Scale.

Problem I.

The Sun's Place or Diſtance from the next Equinoctial Point, and the greateſt Declination being given; to find the preſent Declination.

Example.

The Sun's Place is 26 deg. $\frac{3}{4}$ of *Taurus*, that is, 56 deg. $\frac{3}{4}$ from the *Equinoctial* Point *Aries*; I demand his Declination?

Plate 8. *Fig*. 34.

With the Chord of 60 deg. deſcribe the Semi-circle B D C, and raiſe the Perpendicular A D, and from the Point C ſet off the greateſt Declination 23 deg. $\frac{1}{2}$ from C to E, and draw the Line A E; then for the Sun's Longitude ſet off the Sine 56 deg. $\frac{3}{4}$ upon the Line A E, from A to F; then from the Point F, take the neareſt Diſtance F I to the Line A C, which meaſured on the Line of Sines, is 19 deg. $\frac{1}{2}$; or elſe through the Point F draw G H, parallel to B A C; then A G meaſured on the Sines, or C H on the Chords, gives 19 deg. $\frac{1}{2}$, the Sun's preſent Declination Northerly.

Problem II.

The Sun's greateſt and preſent Declination being given; to find his Place or Longitude.

Example.

The Sun's Declination is 19° $\frac{1}{2}$ North, increaſing; the greateſt Declination (as before) 23° $\frac{1}{2}$: I demand the Sun's true Place.

Plate 8. *Fig*. 34.

Draw B C, and deſcribe the Semi-circle B D C, raiſe the Perpendicular A D, and draw the Line A E, as in the former Problem; place the Sun's Declination 19 deg. $\frac{1}{2}$ from B and C to H and K; draw the Line H K,

which

Plate VII

Fig. 32

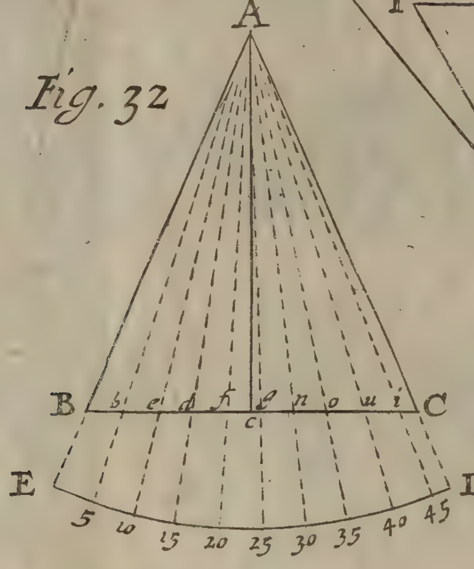


Fig. 30

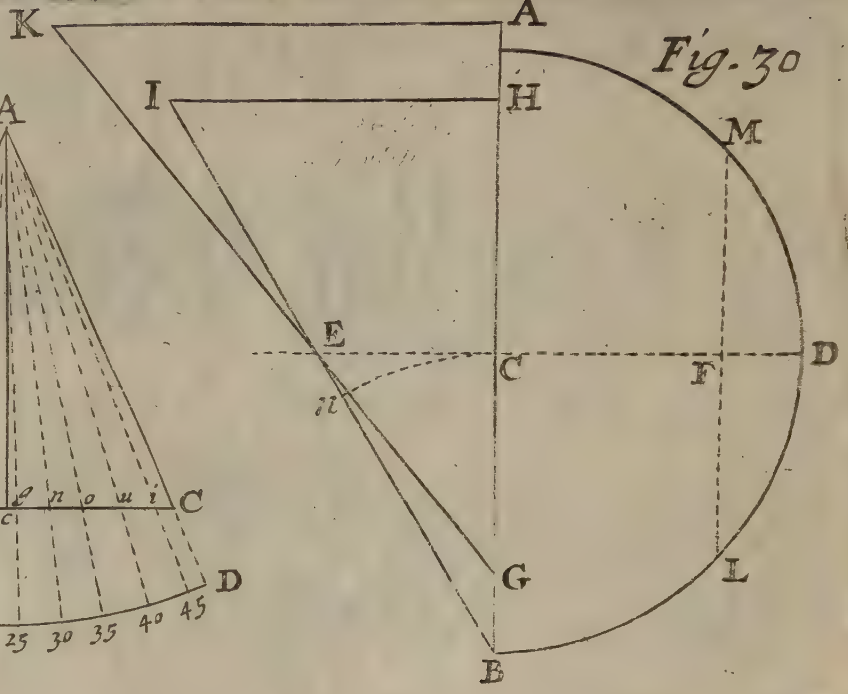


Fig. 31

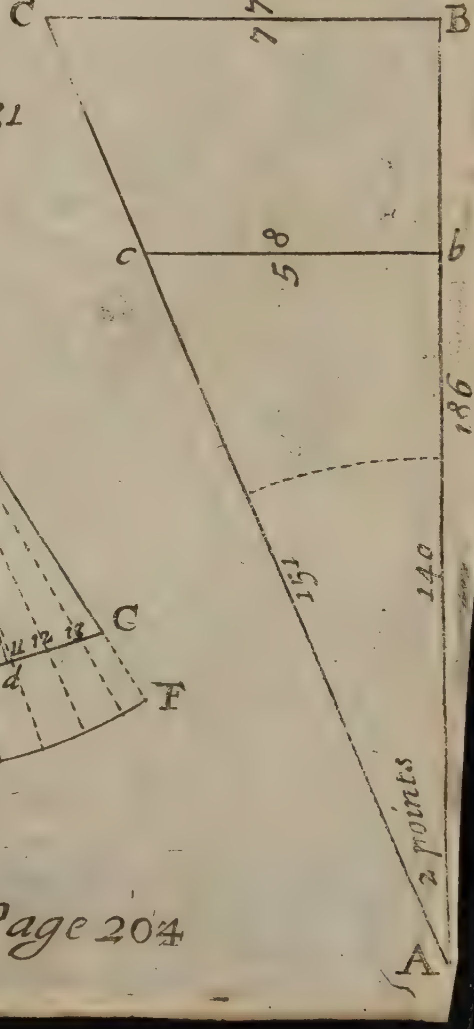
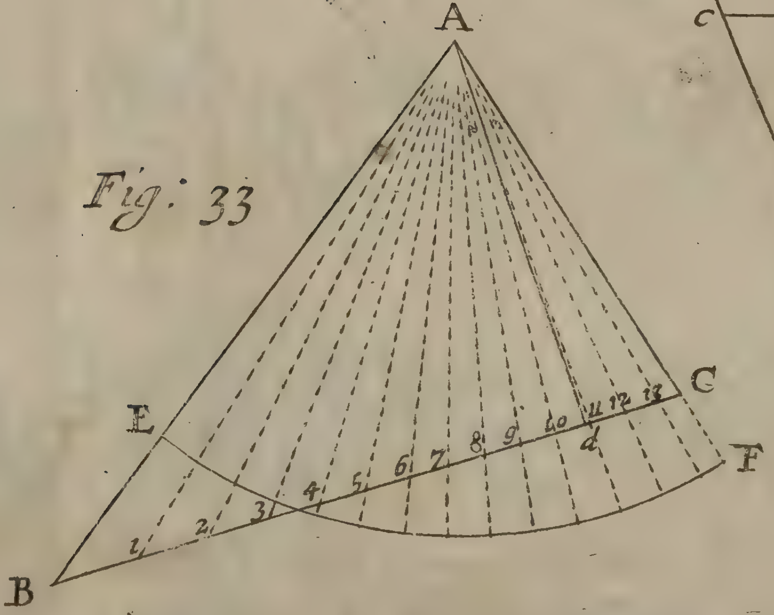


Fig: 33



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which interſects A E in the Point F: the Diſtance A F is a Sine 56° $\frac{3}{4}$, the Sun's Diſtance from *Aries*; ſo that the Sun's Longitude is 26° $\frac{3}{4}$ of *Taurus*.

Problem III.

The Sun's Place and greateſt Declination being given, to find his Right-Aſcenſion.

Example.

The Sun's Place is 26° $\frac{3}{4}$ of *Taurus*, the greateſt Declination as before; I demand his *Right-Aſcenſion*.

Plate 8. *Fig.* 34.

Deſcribe the Semicircle, draw A D and A E as before, place the Sine 56° $\frac{3}{4}$, the Sun's Diſtance from *Aries*, from A to F; through the Point F draw the Parallel H K; then is F G the Sine of the *Right-Aſcenſion*, G H being Radius, which you may meaſure after this manner: Place the Diſtance H G from A to o; upon o as a Center, with the Diſtance F G, deſcribe the occult Arch at m; a Ruler laid from A until it touch the Arch, will cut the Semicircle B D C in the Point N; the Arch C N is the meaſure of F G 54° $\frac{1}{2}$, the *Right-Aſcenſion*.

Problem IV.

The Sun's Declination given, (the greateſt Declination being known) to find the Right-Aſcenſion.

Example.

The Sun's Declination is 19° $\frac{1}{2}$ North increaſing; I demand the *Right-Aſcenſion*.

Plate 8. *Fig.* 34.

Deſcribe the Semicirle B D C, and draw the Line A D and A E as before; place the Declination 19° $\frac{1}{2}$ from B and C to H and K, drawing H K; F G being meaſured as in the third Problem, gives the *Right-Aſcenſion* (as before) 54° $\frac{1}{2}$.

Problem V.

The Latitude of the Place, and the Sun's Declination being given, to find his Amplitude.

Example.

In the Latitude 51° ½ North, the *Sun's Declination* being 17° ¾ N. I demand the *Sun's Amplitude?*

Plate 8. *Fig.* 35.

Draw B A C, and the Semicircle B Z C, the Perpendicular A Z; place the Latitude or height of the Pole 51° ½ from C to P, and draw A P; ſet off the Complement of the Latitude 38° ½ from B to Q, and draw A Q the Equinoctial; place the Chord of the Declination 17° ¾ from Q to D, and the Sine thereof from A to G, and draw the Parallel of Declination D F. A F meaſured on the Line of Sines is 29° ¼, the *Amplitude* required.

Problem VI.

The Latitude of the Place, and the Sun's Declination being given, to find the Aſcenſional Difference.

Example.

In the Latitude 51 deg. ½ North, the Sun's Declination 17 deg. ¾ North; I demand the Aſcenſional Difference.

Plate 8. *Fig.* 35.

Deſcribe the Semi-circle B Z C, and draw the Lines A Z, A P, A Q, and D F, as in the fifth Problem; F G is the Sine of the Aſcenſional Difference to the Radius D G, which is thus meaſured: Place D G from A to o; upon o, as a Center, with the Diſtance F G deſcribe the Arch at E; a Ruler laid from A until it touch the Arch, gives the Point I; and B I 23 deg. ¾ is the Meaſure of the Aſcenſional Difference.

What the Aſcenſional Difference is, and the Uſe of it, may be ſeen *Prob.* 5, 6, and 7. *Chap.* 8.

Problem VII.

The Latitude of the Place, and the Sun's Declination being given, to find when the Sun ſhall be due Eaſt or Weſt.

Example.

In the Latitude 51° ½ North, the Sun's Declination 17° ¾ North; I demand at what time he ſhall be due Eaſt or Weſt.

Plate 8. *Fig.* 36.

Deſcribe the Semicircle B Z C, and draw the Lines A Z, A P, A Q, and D O, as before; E O is the Sine of the time from 6, that the Sun is Eaſt or Weſt (to the Radius D O) to meaſure which, place D O from A to a, and upon the Center a, with the Diſtance E O deſcribe the Arch at g; a Ruler from A, until it touch the Arch, gives the Point L, and B L 14 deg. ¾ is the meaſure of E O, which reduced to time (Vid. *Prob.* 7. *Chap.* 8) makes 59′; which ſhews that the Sun is due Eaſt at 59′ paſt 6 in the Morning, and due Weſt at one minute paſt 5, or 59 min. before ſix at Night.

Problem VIII.

The Latitude of the Place, and the Sun's Declination being given, to find the Altitude of the Sun, being due Eaſt or Weſt.

Example.

In the Latitude 51° ½ North, the *Sun's Declination* being 17° ¾ N. I demand the Sun's Altitude, being due Eaſt or Weſt.

Plate 8. *Fig.* 36.

Deſcribe the Semicircle B Z C, and draw the Lines A Z, A P, Q A, and D O, as before. A E being meaſured on the Line of Sines, is 23° *ferè*, the *Sun's Altitude* being due Eaſt or Weſt.

Problem IX.

The Latitude of a Place, and the Sun's Declination being given, to find the Sun's Altitude at ſix.

Example.

In the Latitude 51° ½ North, the *Sun's Declination* being 17° ¾ N. I demand his Altitude at ſix.

Plate 8. Fig. 36.

Deſcribe the Semi-circle B Z C, draw the Lines A Z, A, Q and D O, and through the Point O draw the Line L o b, parallel to B C; B L or C b meaſured on the Chords, or A I on the Sines, gives 13° ¾, the Altitude of the Sun at ſix.

Problem X.

The Latitude of the Place, and the Sun's Declination being given, to find the Sun's Azimuth at ſix.

Example.

In the Latitude 51° ½ North, the Sun's Declination 17° ¾ North; I demand the *Sun's Azimuth* at ſix.

Plate 8. Fig. 36.

Deſcribe the Semicircle B Z C, and draw the Lines A Z, A P, A Q and D O, as before: draw L o b as in the ninth Problem: I o is the Sine of the Sun's Azimuth to the Radius I L, which is thus meaſured; place I L from A to e. with the Diſtance I o upon the Center e, deſcribe the occult Arch at d; a Ruler laid to touch the Arch, gives the Point b, and C b meaſured is 11 deg, ¾ the Azimuth from the Eaſt or Weſt. So that the Sun is E. by N. at 6 in the Morning, and W. by N. at 6 at Night.

Problem XI.

The Latitude of the Place, the Sun's Declination and Altitude given, to find the Sun's Azimuth.

Example.

In the Forenoon, in the Lat. 51 deg. $\frac{1}{2}$ North, the Sun's Declination is 20 deg. $\frac{1}{4}$ N. and his Altitude 43 deg. I demand his Azimuth.

Plate 8. *Fig.* 37.

Deſcribe the Semicircle B Z C, and draw the Lines A Z, A P, A Q and D F, the Parallel of Declination, as in the former Problems; place the Altitude 43 deg. from B and C to d and e, and draw the Parallel d e, which interſects the Parallel D F in the Point G. I G is the Sine of the Sun's Azimuth from the Eaſt towards the South, I d being the Radius; which to meaſure, place I d from A to c, and thereon with the Diſtance I G deſcribe the Arch at f; a Ruler laid from A to touch the Arch, gives the Point h, B h, 24 deg. $\frac{1}{2}$ is the meaſure of I G, Eaſt Southerly. So that the Sun's Azimuth is S. E. 65 deg. $\frac{1}{2}$.

Problem XII.

The Latitude of the Place, the Sun's Declination and Altitude being given, to find the Hour from Noon.

Example.

In the Afternoon, in the Latitude 51 deg. $\frac{1}{2}$ North, the Sun's Declination is 20 deg. $\frac{1}{2}$, the Altitude 43 deg. I demand the Hour.

Plate 8. *Fig.* 37.

Deſcribe the Semi-circle B Z C, and draw the Lines A Z, A P, A Q, D F, and d e, as in the 11*th* Problem: F G is the Sine of the Hour from ſix, which to meaſure, place D F from A to u, and thereon with the Diſtance F G ſweep the Arch at K; a Ruler laid to touch the Arch, gives the Point o, and C o is the meaſure of F G 45 deg. which reduced into Time, gives three Hours, the time Afternoon.

SECT.

74 50
61"15
13: 35

90 00
68"45
21 15

90
74:50
15:10
21"15
74"45
13-30

SECT. II.

The Uſe of Gunter's *Scale.*

I Shall not ſay any thing of the Deſcription of this Scale, nor of the Projection of the Lines thereon, being the *Logarithms* of Numbers, Sines, Tangents, *&c.* placed upon a Scale. This is ſufficiently explained by Mr. *Gunter*, Mr. *Wingate*, and others.

To find a whole Number on the Line of Numbers.

Among the figured Diviſions look for the firſt Figure of your Number; then for the ſecond Figure, count ſo many tenths for the long Diviſions on towards the end of the Rule, as the Units in the ſecond Figure amount to; then for the third Figure count from the laſt tenth ſo many Centeſms as the Figure hath Units; and ſo likewiſe for the fourth Figure, count from the laſt Centeſm ſo many Millions (or Thouſands) as the ſame fourth Figure contains Units; this done, that ſhall be the Point where the Number propounded is preſented on the Line of Numbers.

The Number given being 12, *to find the Point on the Line of Numbers that doth repreſent the ſame.*

Therefore according to the Rule, 1 being the firſt Figure of this Number, I take the Diviſion at the Figure 1 (in the middle of the Line) for the firſt Figure; then the ſecond Figure being 2, I count two tenths from that 1, and that is the Point repreſenting 12, where commonly there is a ſmall Braſs Center, becauſe 'tis often in uſe.

Suppoſe the Point repreſenting 144 *were required to be found upon the Line of Numbers.*

For the firſt Figure in the Number being 1, I take (as before) the middle 1; then for the ſecond Figure which is 4, I count 4 tenths onwards,

Plate VIII

Fig 34

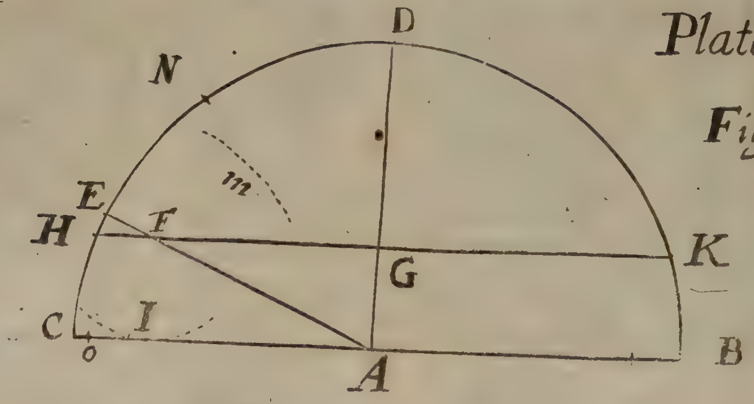


Fig 35

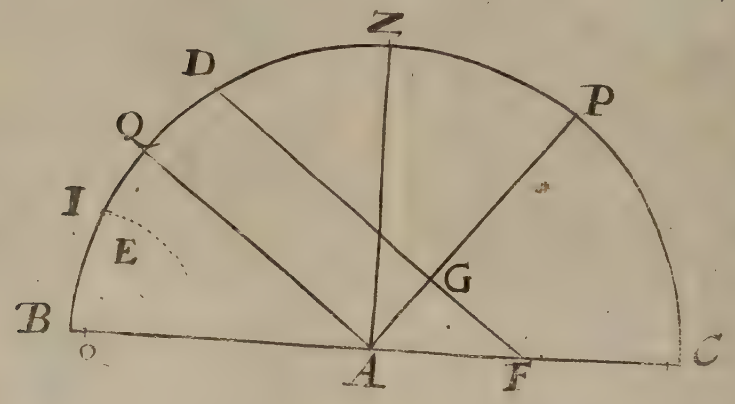


Fig 36

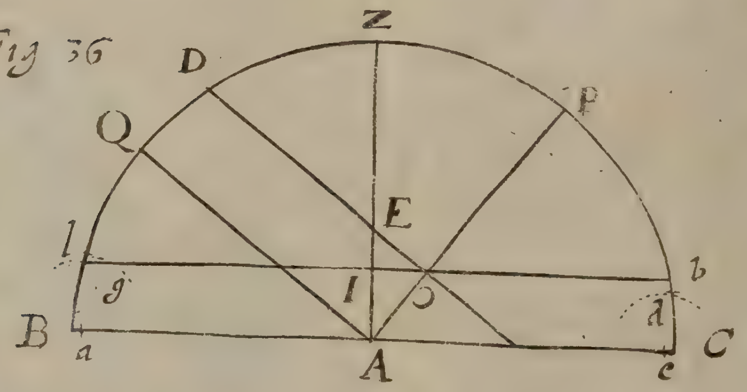
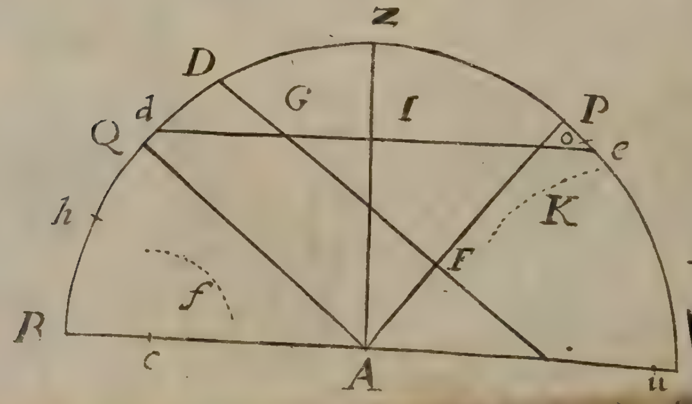


Fig 37



Page 2

wards, and from that tenth I count 4 Centeſms, or hundred parts further, and that is the Point repreſenting 144.

To find the Point repreſenting 1728, firſt (as before) for 1000 I take 1 in the middle of the Line; ſecondly, for the ſecond Figure being 7, I reckon ſeven tenths onwards, and that is 700; thirdly, for the third Figure being 2, I reckon 2 Centeſms from the 7 tenths, which repreſenteth 20; and then laſtly, for 8 you may reaſonably eſtimate 8 Millions, or thouſand parts, from the laſt two Centeſms, and that Point laſt found will be the Point repreſenting the Number 1728.

To find a Fraction, or broken Number on the Line of Numbers.

The Fractions that are to be found on the Line of Numbers, ought always to be Decimal Fractions, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, (or 1, 01, 001) either Inches, Feet, Yards, Perches, or of any other Denomination; all other Fractions muſt be reduced into Decimals; and being thus conſidered, they are expreſſed as whole Numbers upon the Line.

Note.

If you call 1 at the beginning of the Line one tenth of any Integer, then 2 following muſt be two tenths, 3 three tenths, *&c.* and the 1 in the middle, one Integer; 2, two Integers, *&c.* and the 10 at the end muſt be 10 Integers.

But if one at the beginning be one Integer, then 1 in the middle muſt be 10 Integers, and 10 at the farther end 100 Integers; and all the intermediate Figures, 20, 30, 40, 50, 60, 70, 80, 90, ſo many Integers; and every longeſt Diviſion between, as 21, 22, 23, 24, 25, 26, *&c.* ſingle Integers; and the ſhorteſt of thoſe Diviſions, tenths of thoſe Integers; and ſo in proportion, as $\frac{1}{10}$, 1, 10, 100. 10, 100, 1000. 100, 1000, 10000, *&c.*

Problem I.

Two Numbers being given, to find a third Geometrical Proportion, and to a third a fourth, and to a fourth a fifth, &c.

Example.

Let the two Numbers given be 2 and 4, unto which it is required to find a third Proportional, *&c.* Therefore for the performance hereof by the Line of Numbers, extend the Compaſſes from one of the Numbers given to the other; this done, if you apply the ſame Extent either upwards or downwards from either of the Numbers propounded, the moveable Point of the Compaſſes will fall upon the third Proportional required; and ſo the ſame Extent being applied the ſame way, from the third, the moveable Point of the Compaſſes will fall upon the fourth Proportional, and from the fourth to a fifth, *&c.* and ſo to more, as you pleaſe: for if you extend the Compaſſes from 2 to 4, and turn the Compaſſes upwards, with one Point reſting on 4, the moveable Point will fall on 8, the third Proportional, and from 8 to 16, from 16 to 32, from 32 to 64, and ſo forward.

Problem II.

One Number being given to be multiplied by another Number, to find the Product.

To reſolve this Queſtion Arithmetically, whether by natural or artificial Numbers, the Proportion is; As 1 is to the Multiplicand, ſo is the Multiplier to the Product.

Example.

Let the Multiplicand 8 be multiplied by 5 the Multiplier; extend the Compaſſes on the Line of Numbers, from 1 to the Multiplicand; the ſame extent being applied the ſame way from the Multiplier, will cauſe the moveable Point to fall on the Product; for if you extend the Compaſſes from 1 to 8, the ſame extent the ſame way will reach from 5 to 40: and ſo if you would now multiply any Number by 8, as the Compaſſes now ſtand, it is but placing one foot in any Number given, and the moveable Point will fall on the Product; as if you place one foot in 9, the other will fall in 72, and ſo from 8 it will fall in 64, and from 7 to 56, and from 6 to 48: the extent of the Compaſſes may be taken from 10 at the further end of the Line, which you may call 1.

Problem III.

One Number being given to be divided by another Number, to find the Quotient.

For the Reſolution of this Problem, the Proportion is thus; As the Diviſor is to 1, ſo is the Dividend to the Quotient.

Example.

Let 40 be the Dividend, and let the Diviſor be 8; therefore extend the Compaſſes on the Line of Numbers from the Diviſor 8 to 1; this done, the ſame Extent the ſame way ſhall reach from the Dividend 40 to the Quotient, which is 5.

Another Example.

Let 750 be a Number given, to be divided by 25; therefore extend the Compaſſes downwards from 25 to 1, then applying that Extent the ſame way from 750, the moveable Point will fall upon 30, which is the Quotient required.

Now to know of how many Figures any Quotient ought to conſiſt:

It will be neceſſary to obſerve how many Times the Diviſor may be written under the Dividend, according to the Rules of Diviſion; for of ſo many Figures ſhall the Quotient be compoſed.

For Example, 12231 being given to be divided by 27, which ſaid Number may be written, according to the Rules of Diviſion, three times under the Dividend; therefore the Quotient ſhall conſiſt of three Figures, and ſo of any other.

Problem IV.

Three Numbers given, to find a fourth in a direct Proportion, as in the Rule of Three Direct.

To reſolve this Problem, the Proportion is thus; As the firſt Number given is to the ſecond, ſo is the third Number to the fourth.

To perform this on the Line of Numbers, you muſt extend the Compaſſes from the firſt Number or Term given, to the ſecond; which done, that Extent being applied the ſame way from the third Term, will cauſe the moveable Point to fall on the fourth Term required.

Example 1.

If the Circumference of a Circle, whoſe Diameter is 7 Inches, be 22 Inches; what Circumference will a Circle have whoſe Diameter is 14 Inches?

Therefore extend the Compaſſes in the Line of Numbers from 7 in the firſt Part thereof, unto 14 in the ſecond; this done, the ſame Extent being applied the ſame way from 22, will make the moveable Point to fall upon 44 Inches, the Circumference required.

Example 2.

Let the Circumference of a Circle be 22 Inches, and the Diameter thereof 7 Inches; how much ſhall the Diameter of a Circle be, whoſe Circumference is 44 Inches?

Extend the Compaſſes downwards from 22 in the ſecond Part of the Line, to 7 in the firſt; which done, that Extent being applied the ſame way from 44, will reach to 14, the Diameter ſought.

Problem V.

Three Numbers given, to find a fourth in an inverſed Proportion, (or in the backward Rule of Three.)

To reſolve this Problem, the Proportion is; As the third Number is to the ſecond, ſo is the firſt to the fourth.

Example.

If 60 Men make a Trench in 45 Hours, in what time will 40 Men make ſuch another?

To perform this by the Line of Numbers, extend the Compaſſes from the firſt of the Numbers given to the third, having both the ſame Denomination; this done, if this Extent be applied backward from the ſecond Number, the moveable Point will fall upon the fourth Number required; ſo that if you extend the Compaſſes from 60 to 40, (thoſe Terms being of the ſame Denomination, *viz.* of Men) this done, the Extent being applied backward from 45, will reach to 67.5, the fourth Number you look for. I conclude therefore, that 40 Men will perform as much in 67 Hours and a half, as 60 Men will do in 45 Hours.

Problem VI.

Three Numbers given, to find a fourth in a duplicate Proportion.

The Uſe of this Problem is in Proportions of Lines to Superficies, or of Superficies to Lines. Now if the Denomination of the firſt and ſecond Terms be of Lines, then extend the Compaſſes from the firſt Term to the third of the ſame Denomination; this done, that Extent being applied twice the ſame way from the ſecond Term, the moveable Point will ſtay upon the fourth Term required.

Example 1.

If the Content of a Circle, whoſe Diameter is 14 Inches, be 154 Inches; what will the Content of a Circle be, whoſe Diameter is 28 Inches?

Here 14 and 28 having the ſame Denomination, *viz.* of Lines, I extend the Compaſſes from 14 to 28; then applying that Extent the ſame way from 154 twice, the moveable Point will fall on 616, the fourth Proportional ſought; that is, firſt, from 154 to 308, and from 308 to 616.

But if the firſt and third Terms have the Denomination of Area's, or Contents, and the *Quæſitum* be a Line, then extend the Compaſſes upon the Line of Numbers, unto half the Diſtance between the firſt and third Term of the ſame Denomination; ſo the ſame Extent will reach from the ſecond Term given, to the fourth required.

Example 2.

If the Diameter of a Circle, whoſe Area is 154 Inches, be 14 Inches; what Diameter will a Circle have, whoſe Area is 616 Inches?

Divide the Diſtance betwixt 154 and 616 into two equal Parts, then ſet one foot in 14, the other ſhall reach to 28, the Diameter required.

Problem VII.

Three Numbers given, to find a fourth in a triplicate Proportion.

The Uſe of this Problem conſiſteth in the Proportion of Lines and Solids, *& contra.*

If therefore the firſt and third Terms have the Denomination of Lines (as the Diameters of Spheres, or Sides of ſolid Bodies) extend the Compaſſes upon the Line of Numbers, from the firſt Term to the third; this done, and that Extent applied three times the ſame way from the ſecond Term, will cauſe the moveable Point to fall upon the fourth Term required.

Example 1.

If an Iron Bullet, whoſe Diameter is 4 Inches, weigheth 9 Pounds, what is the Weight of another Iron Bullet whoſe Diameter is 8 Inches?

Therefore extend the Compaſſes on the Line of Numbers from 4 to 8; and that Extent applied the ſame way three times from 9, the moveable Point will firſt fall upon 18, then from 18 to 36; and laſtly, from 36 to 72, the Weight required.

But if two given Terms be Weight or Contents of Solids, and the Diameter of a Sphere, or Side of a Cube is ſought, then divide the Space between the two given Terms of the ſame Denomination into three Parts, and that Diſtance ſhall reach from the third to the fourth Proportional.

Example 2.

If an Iron Bullet that weigheth 9 Pound be 4 Inches Diameter, what Diameter ſhall the Shot of Iron be, whoſe Weight is 72?

Divide the Space between 9 and 72 in three Parts, and that third Part ſhall reach from 4 to 8, the Diameter required.

Problem VIII.

To find the Square Root of any Number under 100000.

The Square Root of any Number is always the mean Proportional betwixt 1 and the Number propounded; but yet with this general Caution, *viz.* If the Figures of the Number be even, that is, 2, 4, 6, 8, 10, *&c.* then you muſt look for the Unit, or one, at the beginning of the Line of Numbers, and the Number given in the ſecond Part, and the Root in the firſt Part; or rather reckon 10 at the end to be the Unit, and then both Root and Square will fall backwards towards the middle, in the ſecond Part of the Line; but if they be odd, then the middle one will be beſt to be accounted the Unit, and both Root and Square will be found from thence-forward towards 10; ſo that according to this Rule, the Square Root of 9 will be found to be 3; the Square Root of 64, will be 8; the Square Root of 144, will be 12; the Square Root of 1444, to be 38; the Square Root of 57600, to be 240. And to know how many Figures any Root ought to conſiſt of, put a prick over the firſt Figure, the third, the fifth, *&c.* beginning from the Right-hand; and as many Pricks as are noted, ſo many Figures there muſt be in the Root.

Problem IX.

To find the Cube Root of any Number under 100000000.

The Cube Root is always the firſt of two mean Proportionals between 1 and the Number given, and therefore will be found by dividing the Space between them into three equal Parts. And to find how many Figures will be in this Root, you muſt prick over the firſt Figure, the fourth, ſeventh, beginning at the Right-hand; and ſo many Pricks as you find, ſo many Figures muſt be in the Root, which Root may be eaſily found, with theſe Cautions.

1. If the laſt Prick fall on the laſt Figure towards the left-hand, then the Unit is beſt placed at 1 in the middle of the Line, and then the Cube and Root will both fall forwards towards 10 at the end of the Line.

2. If the laſt Prick fall on the laſt Figure but one towards the Left-hand, you may place the Unit at 1 in the beginning of the Line, and the Cube in the ſecond Part of the Line, then will the Root be found in the firſt Part of the Line.

If the laſt Prick fall on the laſt Figure but two, then place the Unit at 1 at the end of the Line, and then the Cube and Root will both fall backward, and be found in the ſecond Part of the Line of Numbers.

Theſe Notes being obſerved, the Cube Root of 1728, will be found to be 12; and the Cube Root of 17576, will be 26; and the Cube Root of 438976, will be found 76; and the Cube Root of 8120601, will be 201; the Cube Root of 11390625, will be 225.

Problem X.

How to work a Proportion in Sines alone; or, three Sines being given, to find a fourth Proportional.

Example.

As Sine 22° 45′, to Sine 47° 30′; So is Sine 23° 15′, to a fourth Sine required.

This Problem is wrought on the Line of Sines, as the fourth Problem is on the Line of Numbers. Take the Extent from the Sine 22° 45′ on the Line of Sines, to the Sine of 47° 30′; the ſame Extent ſhall reach the ſame way, from the Sine of 23° 15′, to the Sine of 48° 50′, the fourth Sine required.

Problem XI.

How to work a Proportion in Tangents alone; or, three Tangents being given, to find a fourth Proportional.

Example 1.

As Tangent 42° 40′, to Tangent 15° 20′; ſo is Tangent 39° 08′, to the fourth Tangent required.

This Problem is wrought on the Line of Tangents, as the former Problem on the Line of Sines.

Extend the Compaſſes on the Line of Tangents, from the Tangent 42 deg. 40 min. to the Tangent 15 deg. 20 min. the ſame Extent ſhall reach the ſame way, from the Tangent 39 deg. 8 min. to the Tangent 13 deg. 35 min. required.

Example 2.

As Tangent 14° 58′, *to Tangent* 39° 15′; *So is Tangent* 47° 18′, *to a fourth Tangent required.*

On the Line of Tangents, the Tangents above 45°, encreaſe from 45° to 46°, 47° to 50°, 60°, *&c.* backwards towards the beginning of the Line: therefore in working this Proportion, the ſame Extent that reaches from 14° 58′, to 39° 15′, ſhall reach the contrary way from 47° 18′, to 73° 10′, the fourth Tangent required.

Example 3.

As Tangent 21° 30′, *to Tangent* 37° 20′; *So is Tangent* 42° 40′, *to a fourth Tangent required.*

The Extent from the Tangent 21 deg. 30 min. to the Tangent 37 deg. 20 min. if applied the ſame way, from Tangent 42 deg. 40 min. will fall beyond 45 deg. at the end of the Line: therefore to remedy this Inconveniency, having the Diſtance between Tangent 21 deg. 30 min. and Tangent 37 deg. 20 min. place one Point of your Compaſſes in the Tangent 45 deg. and let the other Point fall backwards towards the beginning of the Line, and it will reſt on the Tangent 27 deg. 20 min. This Point let remain fixed, and cloſe the other Point which ſtands in 45 deg. to the Tangent 42 deg. 40 min. then keeping this Diſtance, place one Point in Tangent 45 deg. the other will fall upon the Tangent 60 deg. 45 min. required.

Problem XII.

How to work a Proportion in Sines and Tangents together.

Example 1.

As Sine 22° 30′, *to Sine* 37° 10′; *So is Tangent* 19° 40′, *to a fourth Tangent required.*

The Extent on the Line of Sines from 22 deg. 30 min. to 37 deg. 10 min. ſhall reach on the Tangents from 19 deg. 40 min. to 29 deg. 25 min. required.

Example 2.

As Tang. Compl. 60° 15′, *to Sine* 56° 45′; *So is Radius to a Tangent required.*

Becauſe there is a Tangent in the firſt Place of the Proportion, and likewiſe a Tangent in the fourth, therefore this Proportion muſt be changed by putting Radius in the firſt Place; and inſtead of the Tang. Compl. in the firſt Place, take Tangent 60 deg. 15 min. (if it had been a Tangent, you muſt have taken the Tang. Compl.) and then the Proportion will remain thus:

As Radius to Sine 56° 45′; *So is Tangent* 60° 15′ *to the Tangent required.*

The Extent from Radius, Sine 90°, to the Sine 56° 45′ on the Sines, ſhall reach from Tangent 60° 15′, to Tangent 55° 40′ required.

Example 3.

As Radius to Tangent Compl. 60° 15′; *So is Tangent* 55° 40′, *to a Sine required.*

This Proportion muſt be changed, becauſe there is Radius, or Sine 90 deg. in the firſt Place, and a Sine required. Inſtead of the Tang. Compl. 60 deg. 15 min. take the Tangent 60 deg. 15 min. and put Radius in the third Place, and ſo the Proportion follows;

As Tangent 60 deg. 15 min. to Tangent 55 deg. 40 min. So is Radius to the Sine ſought. Therefore the Extent from the Tangent 60 deg. 15 min. to Tang. 55 d. 40 min. ſhall reach from Radius, or Sine 90 deg. to Sine 56 deg. 45 min. required.

Problem XIII.

How to work Numbers and Sines together.

Example.

As 56 *to* 106 ; *ſo is Sine* 29° 30′ *to a Sine required.*

Extend the Compaſſes on the Line of Numbers, from 56 to 106, the ſame Extent ſhall reach the ſame way on the Line of Sines from 29 deg. 30 min. to 68 deg. 30 min. required.

Problem XIV.

How to work by Numbers and Tangents together.

Example.

As 202 *to* 52 ; *ſo is Tangent* 73° 52′, *to a Tangent required.*

The Extent on the Line of Numbers, from 202 to 52, ſhould reach the ſame way on the Line of Tangents, from 73 deg. 52 min. to the Tangent required; but the Compaſſes ſo extended fall beyond the end of the Line, therefore this Defect muſt be remedied, as in the third *Example*, *Problem* 12. by placing the ſaid extent in Tangent 45°, and letting the other Point fall backwards in the Line, which being fixed, cloſe the other Point to 73 deg. 52 min. and then placing your Compaſſes again in 45 deg. the moveable Point ſhall fall on 41 deg. 40 min. the Tangent required.

SECT. III.

The Deſcription and Uſe of the Sinical-Quadrant.

THis Inſtrument is commonly made of Braſs, Box, or Pear-Tree, being a Quadrant or fourth part of a Circle; the Limb thereof being divided into 90 equal parts or degrees, is numbred with 10, 20, 30, 40, *&c.* unto 90; and alſo is divided into 8 equal Parts, which are the Points of the Compaſs, and doth repreſent any of them according as the Nature of the Queſtion requireth.

The two Sides thereof are commonly divided into 60 (or ſometimes into 100) equal parts, and numbred from the Center with 10, 20, 30, *&c.*

Likewiſe there is an Index that moveth upon the Center of the Quadrant, and reacheth without the Limb, always divided with the ſame equal parts as the Sines, and numbred as before.

And from thoſe equal Parts on the Sides, are drawn Parallels throughout the whole Superficies of the Quadrant, croſſing one another at Right-Angles.

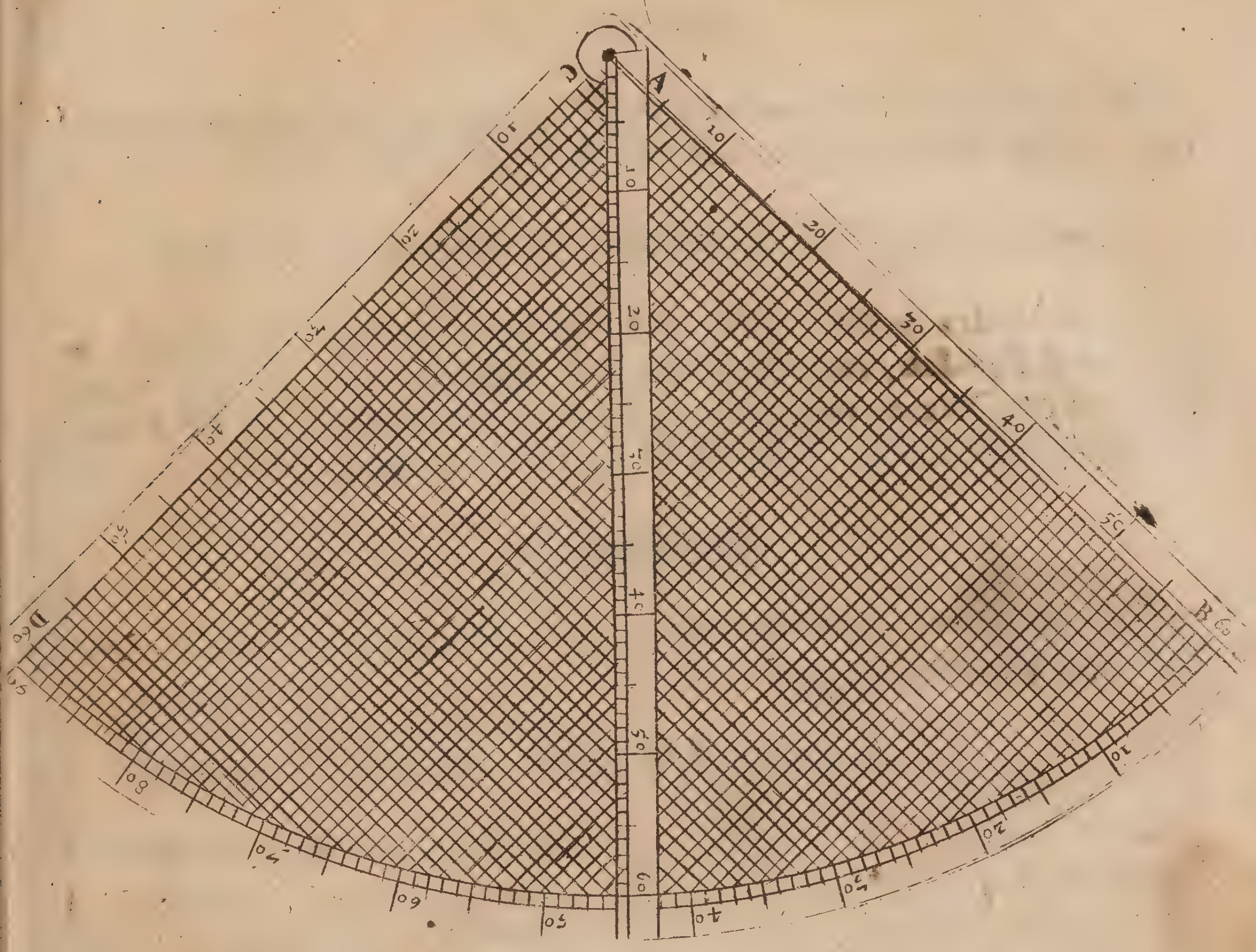
And the Lines of Fives and Tens are commonly prick'd for Diſtinction ſake; which ſaid Lines and Parallels do repreſent the Sines and Sine Compl. of an Arch (divided into equal parts) [which I ſuppoſe is the reaſon why it is called a *Sinical-Quadrant.*]

But here note, that theſe Parallels that proceed from the Side A B, (in the Figure of the *Sinical-Quadrant*) are for Diſtinction called *Sinical Parallels*; and thoſe Parallels that proceed from the Side C D, are called *Co-Sinical Parallels.*

Now theſe Diſtinctions being obſerved, we ſhall proceed to the Uſe, in the Solutions of ſeveral Problems in Navigation, and in working a Traverſe at Sea, *&c.*

The

The Figure of the Sinical-Quadrant.



The Uſe of the Sinical Quadrant.

Problem I.

The Courſe and Diſtance being given; to find the Difference of Latitude, and the Departure from the Meridian.

Courſe the fifth Rhomb, Diſtance 45 *Leagues.*

Therefore firſt put the Index to the fifth Rhomb, which being done, find the *Diſtance* given thereon, which is 45 Leagues; and in the *Sinical Parallels* you will find the Index to cut 25 Leagues, which is the

Difference of Latitude, and in the *Co-Sinical Parallels* it will cut 37 ½, which is the Departure.

Problem II.

The Courſe and Difference of Latitude being given, to find the Diſtance run, and the Departure from the Meridian.

Courſe the third Rhomb, Difference of Latitude 37 ½ *Leagues.*

Set the Index to the Courſe, and find the Difference of Latitude in the *Sinical Parallels*, and where that doth interſect on the Index, is 45, which is the Diſtance required; and where it doth meet the *Co-Sinical Parallels*, there is 25 Leagues the Departure from the Meridian.

Problem III.

The Courſe and Departure being given, to find the Diſtance, and Difference of Latitude.

Courſe the fifth Rhomb, Departure 37 ½ *Leagues.*

Set the Index to the Courſe found in the Limb, and in the *Co-Sinical Parallel* find the Departure 37 ½ (being numbred in the Margin;) and where it doth meet with the Index, it ſheweth the Diſtance run to be 45 Leagues; and where the Index meeteth with the *Sinical Parallels*, there you will find the Difference of Latitude to be 25 Leagues.

Problem IV.

The Diſtance, and Difference of Latitude being given, to find the Courſe and Departure.

Diſtance 45, *Difference of Latitude* 25 *Leagues.*

Firſt, Find the Diſtance run upon the Index, and then move the Index until it doth interſect the Difference of Latitude in the *Sinical Parallels*; and at this Poſition of the Index, look in the Limb, and there you will find the Courſe to be the fifth Rhomb, which was required; and where the *Sinical Parallel* of 25 doth meet with the *Co-Sinical*

Sinical Parallel under the edg of the Index, that will ſhew you the Departure from the Meridian, 37 $\frac{1}{2}$ Leagues on the Side C D.

Problem V.

The Diſtance run, and Departure from the Meridian being given, to find the Courſe and Difference of Latitude.

Diſtance 45 Leagues, Departure 37 $\frac{1}{2}$ Leagues.

Firſt, Find the **Diſtance** run on the Index, put that to the Departure in the *Co-Sinical Parallels*, and that Point ſhall cut in the *Sinical Parallels* the Difference of Latitude 25 Leagues, and the Edg of the Index ſhall ſhew in the Limb the Courſe, which is the fifth Rhomb, which was required.

Problem VI.

The Difference of Latitude, and Departure from the Meridian being given, to find the Courſe and Diſtance.

Diff. of Lat. 25 Leagues, Departure 37 $\frac{1}{2}$ Leagues.

Firſt, Find the Difference of Latitude in the Margin of the *Sinical-Parallels*, and alſo the Departure in the Margin of the *Co-Sinical Parallels*; and note where thoſe Parallels meet each other, in that Point put the Index: then on the Edg of the Index ſhall be cut 45 Leagues, the Diſtance, and on the Limb the Edg of the Index will ſhew the fifth Rhomb, which was required.

Problem VII.

To know how many Leagues you muſt ſail upon any Point of the Compaſs, to raiſe or depreſs a degree of Latitude by the Sinical-Quadrant.

To perform this, you muſt lay the Index upon the Point of the Compaſs, and ſee where the Sinical Parallel of 20 Leagues (which is one degree in the Equinoctial) doth interſect the Edg of the Index, there will be ſhewn the quantity of Leagues you muſt ſail, to raiſe or depreſs the Pole upon any Point of the Compaſs.

As for Example, on the third Rhomb.

If you lay the Index on the third Rhomb, the Sinical Parallel of 20 will ſhew 24 Leagues, which you muſt ſail on that Point to raiſe or depreſs one Degree of Latitude, and that Point on the Index will ſhew in the Sinical Parallels, the Departure from the Meridian to be 13 Leagues $\frac{1}{2}$.

Problem VIII.

Shewing the Uſe of the Sinical-Quadrant *in working a Traverſe at Sea.*

The *Sinical-Quadrant* is a plain and ready Inſtrument for this purpoſe, and is commonly employed for the working ſhort Traverſes at Sea. I'll give one Example of 24 hours run, in the manner as 'tis uſually placed on the *Log-Board*, and how it may be taken off, and wrought by this Inſtrument.

Example.

Admit a Ship at Sea, and bound to the Northward, ſteers away her Courſe North-Eaſt, but then meeting with a contrary and ſhuffling Wind, ſhe makes ſeveral Courſes, as is here under expreſſed in this Table, after the form of the Log-Board.

The form of the Log-board.

H	K	H K	F	C.	W.
2	4	0	0	N. E.	N. W.
4	3	1	0	E. N. E.	N. $\frac{1}{2}$ E.
6	3	0	0		
8	3	0	0		
10	3	1	0	E. $\frac{1}{2}$ N.	N.N.E.
12	4	0	0		
2	4	1	0		
4	3	0	0	E. S. E. $\frac{1}{2}$ E.	N. E.
6	3	1	0		
8	4	0	0		
10	5	0	0	N.by W. $\frac{1}{2}$ W.	
12	4	1	0		

Theſe Log-Boards are made fit for Uſe, together with Log-Books ready rul'd, and ſold by the Author.

In this Table there are ſix Columns; the firſt diſtinguiſhed with H, ſhews the Time, or Hours at which theſe Courſes and Diſtances are thus ſet down upon the Log-Board, that is, at 2 of the Clock, 4 of the Clock, 6 of the Clock, *&c.* the Log being commonly hove every two Hours.

The ſecond, third, and fourth Columns ſhew the Knots, half-Knots, and Fathoms, that the Ship runs upon any Courſe in the ſpace of half a minute, meaſured by the Log-Line.

The fifth Column contains the Courſe ſteered by the Compaſs, but the Lee-way that the Ship makes, is left to the Diſcretion of the Calculator to be allowed according to the Mould of the Ship, and the Sail ſhe bears, and alſo having reſpect to the Wind and Sea at the ſame time.

The ſixth Column ſhews on what Point of the Compaſs the Wind is, and manifeſting whether the Courſe be large, or upon a Wind.

Thus much for the Form of the Log-Board, and the manner of ſetting down the Courſes and Diſtances thereon. Now ſomewhat briefly, how to take off (as they call it) this Account from the Log-Board, thereby to compute the Ship's true Courſe and Diſtance by the *Sinical-Quadrant*, or other Inſtrumental or Arithmetical Calculation.

'Tis uſual for the Maſter, his Mates, and all others that are deſirous to keep a reckoning of the Ship's Way, every Day at Noon, when the Ship is at Sea, to take an account of the ſeveral Runs upon the Log-Board for 24 hours laſt paſt, taking notice of the Wind, and other Accidents, allowing for every Knot and half-Knot, ſo many Miles and half Miles run in one hour, and four times ſo many in a Watch, or four hours: And becauſe 'tis uſual to heave the Log but twice in a Watch, or every two hours, and the Courſe ſet down accordingly; therefore the Knots and half-Knots upon the Log-Board for each Courſe muſt be added together, and the total doubled, gives the number of Miles upon each reſpective Courſe: As for Inſtance, in this Example in the Table, under the Letters H, K, HK, *&c.* in the firſt Line, you will find 4 Knots N. E. which being doubled, give 8 Miles, the Diſtance upon that Courſe: but now for the more orderly working the 24 hours Run, it is convenient to frame a Table, after the form of this here annexed.

The

The Operation of theſe Traverſes by the Sinical-Quadrant.

1. The firſt Courſe is North-Eaſt 8 Miles, the Wind large, therefore lay the Index upon the fourth Rhomb, or 45° from the Meridian, you ſhall find the Diſtance run 8 Miles upon the Index to interſect at 5 ½ in the *Sinical Parallels*, which is the Northing, and is to be placed in the North Column, and to cut 5 ½ in the *Co-Sinical Parallels*, which is the Eaſting, to be placed in the Eaſt Column: and the reaſon why the Difference of Latitude and Departure, now found by the *Sinical-Quadrant*, is ſet under the North and Eaſt Columns, is, becauſe the Courſe is between the North and Eaſt.

A Table of the Northing, Southing, Eaſting and Weſting of thoſe Courſes, found by the Sinical-Quadrant.

Courſe.	Diſt.	N.	S.	E.	W.
	Miles	Miles	Miles	Miles	Miles
N. E.	08	05 ½		05 ½	
E. by N.	19	03 ½		18 ½	
E. ½ S.	24		2 ¼	24	
S. E. by E. ½ E.	21		10	18 ½	
N. N. W. ½ W.	19	17			09
Sum.		26	12 ¼	66 ½	09
		12 ¼		09	
Diff. of Lat.	No.	13 ¾		57 ½	E.

2. The ſecond Courſe is Eaſt by North 19 Miles upon a Wind, the Courſe ſteered is Eaſt North-Eaſt, the Ship lying within 5 ½ Points of the Wind, and allowing one Point for Leeward-way, the true Courſe is, as before, E. by N. Therefore place the Index to the ſeventh Point or 78° ¾ from the Meridian, and by 19 Miles, the Diſtance, there

will be cut 3 ½ Miles, in the *Sinical Parallels*, which is the Northing, and 18 ½ Miles in the *Co-Sinical*, which is the Eaſting.

3. The third Courſe is (allowing, as before, one Point for Leeward-way) Eaſt ½ a Point Southerly, and the Diſtance 24 Miles; therefore lay the Index to 7 ½ Points, or 84 deg. ¼, and by 24 found on the Index, ſhall be cut 2 ¼ in the *Sinical Parallels*, which is the Southing, and 24 *ferè* in the *Co-Sinical*, which is the Eaſting of this Courſe and Diſtance.

And what hath been ſaid of theſe three Courſes, the ſame is to be underſtood of the reſt in the foregoing Table, giving the ſame Allowance as before, the Ship being ſtill by a Wind.

Having thus therefore, according to theſe laſt Inſtances, found the Northing and Southing, Eaſting and Weſting of theſe ſeveral Courſes and Diſtances, and placed them in their proper Columns, ſum up the Miles in thoſe Columns, and orderly ſubſcribe their Total, as in this Example.

The Sum of the North Column is 26 Miles, of the South Column 12 ¼; of the Eaſt, 66 ½, and of the Weſt, 9 Miles.

Then compare the North and South Columns together, and alſo the Eaſt and Weſt; and deduct the leſſer from the greater, as in the foregoing Table: The Southing is to be ſubtracted from the Northing, and the Weſting from the Eaſting; the Remainder Northerly 13 ¾ Miles, is the Difference of Latitude; the Reſidue under the Eaſt Column, 57 ½ Miles, is the Departure to the Eaſtward of the Meridian.

And if the direct Courſe, and neareſt Diſtance from the place where the Ship began this Traverſe, to that where ſhe now is ſuppoſed to be, were required, 'tis readily computed by the *Sinical Quadrant*. And to perform this, find where 13 ¾ in the *Sinical Parallels* interſect the *Co-Sinical Parallel* of 57 ½, and bring the Index to that Point, and by the Index in the Limb ſhall be ſhewn the Angle of the Courſe, 76 deg. ½, or 7 Points from the Meridian, *viz.* E. by N. and the Diſtance run, found on the Index, will be 59 Miles.

And thus after the form of this firſt Example, you may find the Difference of Latitude and Departure from the Meridian of any 24 hours Traverſe, and likewiſe reduce it to one Courſe and Diſtance.

And what is here in particular applied to the *Sinical-Quadrant*, the ſame is to be underſtood of the other Inſtruments, it being only a Repetition of the firſt Caſe, by the Courſe and Diſtance given, to find the Difference of Latitude and the Departure, which found, is orderly to be placed in a Table, as in the foregoing Example.

Having ſpoken ſomewhat of the Log-Board, and of the Uſe thereof, I think it not amiſs here to ſay ſomething of the Log-Line, and Half-Minute Glaſs.

An Advertiſement concerning the Log-Line, and Half-Minute Glaſs.

Seeing that the manner of keeping a Reckoning of the Ship's way (by our *Engliſh Navigators*) is commonly by the Log-Line, and Half-Minute Glaſs, there ought to be great care had to the truth of them: but it hath been an antient Cuſtom to meaſure ſeven fathom between Knot and Knot upon the Log-Line; which way of meaſuring hath been grounded upon a meer conjecture, that five of our Feet make a Pace, and a thouſand ſuch Paces make a Mile, and that ſixty ſuch Miles make a Degree; ſo that a Degree ſhould contain 300000 of our Feet, and one Mile (or Minute) 5000 Feet; and becauſe an half-Minute of Time is the 120*th* part of an Hour, the Log-Line ſhould anſwer to that Proportion, and be the 120*th* part of a Mile, which by this acoount is 41 $\frac{2}{3}$ Feet between each Knot on the Log-Line.

But this erroneous Computation hath been ſufficiently refuted by Mr. *Oughtred*, Mr. *Norwood*, and others.

Mr. *Oughtred* in his *Circles of Proportion*, p. 153. doth there propoſe 66 $\frac{1}{4}$ Statute-Miles to anſwer to one Degree upon the Earth, each containing 5280 Feet; ſo that according to this Computation, there is 34980 Feet in one Degree.

And Mr. *Norwood*, in his *Seaman's Practice*, p. 43. doth declare, *That* (by a worthy and commendable Experiment of his) *he found a degree of the Circumference of the Earth and Sea, to contain* 367200 *of our Engliſh Feet.* But he further conſenteth, *That becauſe the Ship's way is more than doth really appear by the Log-Line, and becauſe it is more ſafe to have the Reckoning to be ſomewhat before the Ship, together with the Evenneſs of Number to allow but* 360000 *Feet to be one Degree, and conſequently* 6000 *Engliſh Feet to be one Minute, or the ſixtieth part of a Degree (vulgarly called a Mile) which Number being divided by* 120, *giveth* 50 *Feet between Knot and Knot on the Log-Line; ſo that upon this ground, if a Ship runneth out one of thoſe Knots in half a minute, ſhe runneth one Mile (or the ſixtieth part of a degree) in an Hour, or one League and one Mile in a Watch, or* 4 *Hours.*

Likewiſe Monſieur *Picart* has lately meaſured the Length of one Degree in *France*, and finds it to contain 365184 Engliſh Feet; nearly agreeing with Mr. *Norwood.* But notwithſtanding theſe Experiments (together with the Conſent and Approbation of other Accompliſhed Mathematicians in their Books of *Navigation*) have ſufficiently detected this Error; yet this Truth hath not had that Entertainment, as the Excellency thereof hath deſerved, becauſe Cuſtom hath ſo long prevailed againſt Reaſon.

Mr. *Norwood*, in his fore-mentioned Book, hath aſſigned ſome Reaſons why he ſuppoſeth this Error hath been ſo long received and tolerated; I ſhall forbear to mention them, referring you to the Book it ſelf. But I ſhall aſſign one Reaſon more, which I have obſerved from Experience, which, I hope, will in ſome meaſure help to prove the Truth of Mr. *Norwood*'s Experiment, and that the Log-Line (as commonly divided) may be proved to be too ſhort for true meaſure: for I have obſerved, that if a half-minute Glaſs be made of its due length, according to true Time, that then their Reckonings intolerably out-run the Ship, and they continually complain, that thoſe Glaſſes are too long: But if they have a Glaſs that is 5 ſeconds ſhorter than true Time, they do reaſonably well agree with the Log-Line in their Reckonings; becauſe one Error doth ballance another, *viz.* ſhort meaſure, and ſhort time. Yet notwithſtanding this Concurrence and Affinity between this Log-Line, and ſhort Half-minute Glaſs, it is apparent that they are both Errors, and therefore to be rejected: for I ſuppoſe it would quickly appear that if the Log-Line were of its due length and meaſure, *i. e.* 50 Foot between each Knot, and the half-Minute Glaſs of its due length, according to true Time, there would doubtleſs be a greater Harmony and Concurrence of Truth, and Navigation be of more certainty than it is.

So that now it doth plainly appear, by this above-mentioned Obſervation, that the Log-Line, as commonly divided, is too ſhort, according to Mr. *Norwood*'s Experiment, becauſe the neceſſity of keeping a Concurrence in the Reckonings, is by a Glaſs that is too ſhort by 5 ſeconds for the true time of half a minute, or 30 ſeconds.

But here I ſhall give you a Rule, to prove whether a Half-Minute Glaſs be of true length or not; the way is generally approved to be very true, and what I have many times made Experience of, and can atteſt it by my own Knowledg. The Experiment is mentioned by Mr. *Philips*, in his *Advancement of Navigation*, and is thus to be performed.

An eaſy and exact Way to meaſure a Half-Minute Glaſs, or any ſmall Portion of Time.

Take a Bullet of any weight whatſoever, and make faſt a piece of Thread or Silk to it, being 38 ½ Inches in length, from the Center of the Bullet unto the end of the Thread, where a Nooſe muſt be made to hang it on a ſmall Pin, which is to be faſtened to any Place where the Bullet may ſwing freely.

This *Pendulum* being thus prepared, hang its Nooſe on the Pin, the Thread being exactly 38 ½ Inches between the Center of Gravity, and the Center of Motion, each of the Swings of this Bullet (being either ſwift or ſlow) ſhall be a true ſecond of Time, ſo that 60 of theſe Swings will be the true length of a Minute, and 30 the true length of half a Minute. So by this ingenious Experiment you may know which of all your Half-Minutes is a true Glaſs: and if you have no Glaſs, you may meaſure any ſmall Portion of Time by this Experiment; for half a ſecond of Time is diſcovered every time the *Pendulum* doth paſs the Perpendicular, that is ſuppoſed to fall from the Pin whereon the *Pendulum* doth hang.

But if it ſhould be objected, That at Sea, when the Ship is thrown to and again by the Violence thereof, that then the *Vibrations* of the *Pendulum* may by that means be obſtructed, and ſo the Swings to be uncertain.

A Remedy there is found againſt this Objection, by making the Thread 7 Inches ſhorter, and thereto make a ſmall Knot, which Knot you are to hold between your Finger and Thumb, and then with the motion of your Hand, to cauſe the Bullet always to aſcend to an Angle of 60 degrees (from the Perpendicular) and ſo ſhall each Swing be equivalent to thoſe before; ſo that if a Ship be toſſed by the Violence of the Sea, yet a Man may make ſhift to try this Experiment, and to meaſure a true Half-Minute of Time without the help of a Glaſs.

SECT.

SECT. IV.

The Deſcription and Uſe of the Plain Charts, commonly call'd Plats.

THeſe Charts are drawn upon Vellom, and paſted upon Boards, and are commonly called *Plats*; in the middle thereof is a Center, upon which there is an occult Circle deſcribed, which is divided into 32 Parts or Points; by which are drawn ſeveral Lines quite through the Plat, repreſenting the Rhombs or Points of the Compaſs, and upon theſe Lines are other Circles deſcribed and Rhomb-Lines drawn, parallel to the former.

Then is the Form of the Land poutrayed upon it, and ſet off with Colours, and alſo a Scale of Leagues to meaſure the Diſtances of Places.

There is alſo a Meridian Line equally divided upon the Plat; which diſcovereth the Latitude of any Place. The ſeveral Uſes follow.

The Uſe of the Plat.

1. *To find the Latitude of any Place upon the* Plat.

Take your Compaſſes, and ſet one foot in the Place required, and extend the other foot to the neareſt Diſtance of an Eaſt and Weſt Line, and note where that Line doth cut the Meridian-Line (that is divided into degrees); then ſet one foot where it interſects the Meridian-Line, and the other foot will reach upon the Meridian-Line, to the Latitude of the Place required.

2. *To find the Diſtance of one Place from another.*

If the Diſtance required be leſs than the length of the Scale, then take your Compaſſes, and ſet one Foot in one of the Places, and the other foot in the other place, then with the Extent between your Compaſſes applied to your Scale of Leagues, will give the meaſure of the Diſtance of the two Places.

But if the Diſtance between the two Places be greater than the length of the Scale, then firſt extend your Compaſſes upon the Scale to the whole length thereof, and with that extent ſet one foot in one of the Places required, then direct the other foot towards the other Place by the help of a Scale, or Ruler in a Right-Line; and if the Diſtance be great, you muſt turn the Diſtance between the Compaſſes over twice, thrice, or oftner, until you come to the other Place required; and if it falls out, that the laſt extent doth fall over the ſecond place, you muſt then, from the laſt Place where the Compaſſes ſtayed, draw in the other Point, until it touch in the Place required, and meaſure that upon the Scale of Leagues. As ſuppoſe your Scale were an hundred Leagues; and if you turn your Compaſſes two or three times over, then is the Diſtance ſo many hundred Leagues, and that ſmall Diſtance more; which being meaſured upon the Scale, it giveth the odd Leagues, and ſo conſequently the Diſtance required.

3. *To find upon what Point of the Compaſs one Place beareth from another.*

If from the two Places propounded, there be a Rhomb-Line that lieth directly from Place to Place, then is there no more trouble in it, but to look upon the ſmall Compaſs upon the Plat, and ſee upon what Rhomb it is that they bear one from another.

But in caſe a Rhomb-Line doth not lie directly from one Place to the other, then extend your Compaſſes from the firſt Place in the neareſt diſtance to the next Rhomb-Line, that you imagine in your Judgment lieth neareſt a Parallel from Place to Place, and upon that Rhomb-Line run your Compaſſes along, till the other Point (being at Right-Angles with it) doth reach the other Place, and that Rhomb-Line is the true Point of bearing the one from the other.

4. *To keep a Reckoning upon the Plat of a whole Voyage.*

Firſt, It is to be underſtood, that you are to keep a Reckoning of every day's Work, either by the Tables, or your *Sinical Quadrant*, (as you are before taught) or any other way neceſſary for ſuch a purpoſe; and alſo to caſt up all your Traverſes for one or more days: and then after you have ſo done, and brought it to the neareſt Truth you can, either by Obſervation or otherwiſe, then you are to ſet off your Work upon your Plat, ſo that the Place where your Ship is, may appear to your Eye for the Satisfaction of your Mind, and for the Information of your Judgment.

As ſuppoſe that you ſail from the *Lizard* South-weſtwards; then from that very time you begin to keep your Reckoning of your ſeveral Courſes and Diſtances, until you have ſome convenient Time to caſt up all your Work, to find the Difference of Latitude, and your Departure from the Meridian of the *Lizard.* The Difference of Latitude we will ſuppoſe to be 3°, and the Departure to be 50 Leagues, which 3° you muſt ſubtract from the Latitude of the *Lizard*, which we ſuppoſe to be 50° 00′ North; ſo that the Latitude that the Ship is now in, is 47° 00′, and 50 Leagues to the Weſtward.

Therefore to ſet the place of your Ship upon your Plat, you muſt uſe two pair of Plat-Compaſſes: with one pair take the extent between the Latitude of 50° 00′ and 47° 00′, and ſet one Point of your Compaſſes in the *Lizard*, and extend the other Point towards the ſecond place, but ſo that your Compaſſes may ſtand parallel to a North and South-Line, which may be eaſily found with the other pair of Compaſſes, by trying whether the Legs be equi-diſtant from the next North and South Line: This done, keep one foot of your Compaſſes in that Point, and with the other pair take the Departure 50 Leagues, from the Scale of Leagues; then interchange your Compaſſes, placing theſe laſt pair in the Point where the other pair ſtood; ſet this Departure 50 Leagues to the Weſtward, and ſo that your Compaſſes may ſtand parallel to an Eaſt and Weſt Line, which you may try as is ſaid before. The ſecond Point thus found upon the Plat, is the place of the Ship (according to your Reckoning) which was required.

Thus much for the Plat, *or* Plain-Chart.

SECT. V.

The Uſe of the true Chart, commonly called Mercator's *Chart.*

I Shall not here mention the Projection of this Chart, it being largely handled by the firſt Inventor, Mr. *Edward Wright*, in his *Correction of Errors*, only here ſhew very briefly the ordinary and moſt neceſſary Uſes of this Chart.

1. *To find the Latitude of any Place in theſe Charts.*

This Operation upon theſe Charts is in all reſpects like that which has already been delivered for the ſame purpoſe, in the Uſe of the *Plat*, or plain Sea-Chart ; for if you ſet one Point of your Compaſſes in the place whoſe Latitude is required, and open them in the ſhorteſt Diſtance to the next Eaſt and Weſt Line, obſerving where it interſects the graduated Meridian, and then place one Point in that Interſection, turning your Compaſſes upwards or downwards, according as the Place lies, from the Eaſt and Weſt Line, and the moveable Point ſhall ſhew upon the ſaid Meridian the Latitude of the Place required.

Suppoſe the Latitude of *Uſhant* were required by this Chart ?

If you take the neareſt Extent to an Eaſt and Weſt Line, and place that Diſtance from the Interſection on the graduated Meridian, as is before directed, you will find the Latitude of *Uſhant* to be 48 deg. 40 min. Northerly.

2. *To find the Longitude of a Place, and conſequently the Difference of Longitude in degrees, between any two Places ſituate upon the Chart.*

To find the Longitude of any Place upon the Chart, ſet one Point of your Compaſſes in the ſaid Place, and take the neareſt Diſtance to the next North or South Line, and obſerve where this Line interſects the Equinoctial ; and keeping the ſame Extent in your Compaſſes, place one Point in the Interſection, and turning the Compaſſes the ſame way that the Place, whoſe Longitude is ſought, lies from the North and South Line, the moveable Point reſting in the Equinoctial, will ſhew the Longitude required.

Suppoſe the Longitude of the *Barbadoes* were required.

If you place the Point of your Compaſſes in the Iſland of *Barbadoes* in the Chart, and take the ſhorteſt extent to the next North and South Line, placing the ſame at the Interſection in the Equinoctial, as is directed, you will find the Longitude of the *Barbadoes* to be in theſe Charts 319° 40′ from *Teneriff.* But the Longitude of Places being various, according to the Place from whence it is begun, ſome reckoning it from *Flores* and *Corvus*, ſome from *Teneriff*, *&c.* the chief Buſineſs will be to find the Difference of Longitude between any two Places: which is thus to be performed.

When you have found the Longitude of the two Places, ſubtract the leſſer from the greater, and the Remainder, if leſs than 180 deg. is the Difference of Longitude between the two Places; but if the Remainder be greater than 180 deg. ſubtract it from 360, the laſt Remainder is the Difference of Longitude required.

Suppoſe the two Places were the *Lizard*, in the Longitude 12° 40′, and *Thoma* Iſland in the Longitude 27° 30′, ſubtracting 12° 40′ from 27° 30′, the Remainder 14° 50′ is the Diff. Long.

Again, Suppoſe the two Places were the *Lizard*, as before, and *Barbadoes* in the Longitude 319° 30′, ſubtracting 12° 40′ from 319° 40′, there remains 307° 00′, which ſubtracted from 306°, the Remainder 53° 00′ is the Difference of Longitude required.

3. *To know how one Place bears from another.*

For the performance of this *Problem*, lay the edg of a Ruler from one Place to another, and with a pair of Compaſſes try to which of the Rhomb-Lines the Edg of the Ruler is the neareſt Parallel, which being found, that ſheweth the Point of the Compaſs the two Places bear one from another.

Suppoſe the bearing of the *Barbadoes* from the *Lizard* were required.

Therefore lay the edg of the Ruler upon both Places, and you will find, that South-Weſt ½ a Point Weſterly, is the neareſt Parallel thereto, which is the bearing of the *Barbadoes* from the *Lizard*, and the oppoſite Point North Eaſt ½ Eaſt, the bearing of the *Lizard* from the *Barbadoes*.

4. *To find the Diſtance of two Places upon* Mercator's *Chart.*

If both Places be in one and the ſame Latitude, take with your Compaſſes the length of a degree of the Meridian of that Latitude, (taking half the degree above, and half beneath the Latitude) for ſo oft as you ſhall find that length between the two Places, ſo many times 20 Leagues are there betwixt them; but if the Diſtance be great, for Expedition, you may take five times the length of that degree, and counting it for 100 Leagues, proceed as before,

Suppoſe the Diſtance were required between the Point of *Uſhant* and *Cape-bona-viſta* in *New-found-land.*

The Diſtance taken as before about the Latitude of 49°, you will find it to be 560 Leagues.

But if two Places have not the ſame Latitude, the Equinoctial not coming between them, ſubtract the leſſer Latitude out of the greater; but if the Equinoctial cometh between them, and both Latitudes together, ſo have you the Difference of Latitude between both Places.

Now if both Places have the ſame Longitude, ſo many degrees as there are in the Difference of Latitude, ſo many times 20 Leagues is the Diſtance.

But if the Places differ both in Latitude and Longitude, then look how many degrees the Difference of Latitude contains, ſo many degrees of the Equinoctial take between your Compaſſes; then lay a Ruler to both Places whoſe Diſtance you ſeek, and obſerve where the Ruler croſſes the Equinoctial, or ſome other Eaſt or Weſt Line, (or Parallel of Latitude) and leading one foot in the Equinoctial or other Parallel, move forwards the other alſo parallel-wiſe, keeping always that Diſtance, till it croſs the Rhomb of thoſe two Places in ſuch ſort, that one foot reſting by the Edg of the Ruler, the other carried about, may but only touch the Equinoctial or other Parallel cut by the edg of the Ruler; then take with your Compaſſes the Segment, or part of that Rhomb between that place and the croſſing of the Equinoctial or Parallel, which meaſure in the Equinoctial, and ſee how many degrees are contained betwixt them, ſo many times 20 Leagues is the Diſtance of thoſe two Places.

Or, if that Segment of the ſaid Rhomb be greater than can well be taken with the Compaſſes, take the Length of 5 degrees of the Equinoctial between your Compaſſes, and look how oft you can find that length in the Segment of the Rhomb aforeſaid, for ſo many hundred Leagues is the Diſtance of thoſe two Places.

If the Diſtance from the *Lizard* to the *Barbadoes* were required, the Difference of Latitude between thoſe Places is $36^\circ 48'$; therefore take $36^\circ 48'$ from the Equinoctial, and lay a Ruler over both Places, until it will croſs ſome parallel of Latitude; then keeping this Diſtance of degrees in your Compaſſes, apply one Point to the Edg of the Ruler, ſo that the other Point may but juſt touch the Parallel croſſed by the Ruler; the Segment of the Rhomb, between the Point where the Compaſſes ſtay, and the Interſection by the Ruler and Parallel of Latitude, meaſured by the Degrees of the Equinoctial, gives the Diſtance 1140 Leagues, which was required.

There is nothing elſe that will be of any difficulty in the common Uſe of this Chart, if theſe brief Hints be underſtood.

SECT. VI.

The Deſcription and Uſe of the Globes.

OF Globes there are two ſorts; one is *Terreſtrial*, and the other *Celeſtial*.

The *Terreſtrial* hath on the *Superficies* of the Body pourtrayed and deſcribed the whole Form and Faſhion of the Earth and Sea, with the Circles of the Sphere, as Colures, Equinoctial, Tropicks, *&c.*

The *Celeſtial* Globe hath on its Surface the Conſtellations of all the known Stars in the Heavens, placed in their Latitudes and Longitudes, Right-Aſcenſions and Declinations, drawn into ſeveral Images and Figures, according to the Fictions of the Antients, with the Circles of the Sphere, as in the Terreſtrial Globe.

Geographical Definitions, neceſſary to be underſtood.

Defin. I.

The Globe of the Earth is a Spherical Body, compoſed of Earth and Water, and is divided into Continents, Iſlands, and Seas.

II.

A Continent is a great Quantity of Land not divided nor ſeparated by the Sea, wherein are many Kingdoms and Principalities; as *Europe*, *Aſia*, and *Africa* are one Continent, and *America* is another.

III.

An Iſland is ſuch a part of the Earth that is environed round with Water; as the Iſland of *England* and *Scotland*, and alſo *Ireland*, the Iſle of *Wight*, *Barbadoes*, &c.

IV.

A *Peninſula* is ſuch a part of Land as is almoſt encompaſſed about with Water, and is only joined with the Land by an *Iſthmus*; ſuch is that great part of Land in *America*, called *Peruviana*, and *Morea* in the *Levant*.

V.

An *Iſthmus* is a narrow Neck of Land, which joineth the *Peninſula* to the Continent.

VI.

A *Promontory* is ſome high Mountain, or great Cape of Land, that ſhooteth it ſelf into the Sea; as *Cape Bon Eſperance*, or *Cape de Verde* in *Africa*.

VII.

The *Ocean* is a general Collection of the Waters, which environeth the Earth on every ſide.

VIII.

The *Sea* is a part of the Ocean, to which we cannot come but through ſome Strait, as the *Mediterranean*, and *Baltick* Sea.

IX.

A *Strait* is a part of the *Ocean*, reſtrained with narrow Bounds, and opening a way to the Sea; as the Straits of *Gibralter* that leadeth into the *Mediterranean*, and the *Sound* that leadeth into the *Baltick* Sea.

X.

A *Creek* is a ſmall narrow part of the Sea, or Rivers that go up but a little way in the Land.

XI.

A *Bay* is a great Inlet of the Land, as the Bay of *Biſcay*, and the Bay of *Mexico*.

XII.

A *Gulph* is a great Inlet of the Land, deeper than a Bay; ſuch is the Gulph of *Venice*, and the Gulph of *Florida*.

XIII.

A *Climate* is a certain ſpace of Earth and Sea, that is included within the ſpace of two Parallels; and of them there have been antiently accounted ſeven:

1. *Dia Meros.* 2. *Dia Syenes.* 3. *Dia Alexandria.* 4. *Dia Rhodes.* 5. *Dia Rhomes.* 6. *Dia Boriſthenes.* 7. *Dia Ripheos.* But now there are 24 on each ſide of the Equator, ending where the longeſt Day is 24 Hours.

XIV.

A *Zone* is a certain ſpace of Earth, contained between certain Circles of the Sphere, and are thus divided:

The Earth is divided into five *Zones*, *viz.* one Torrid or Burning *Zone*, two Temperate, and two Frozen *Zones*.

The Torrid *Zone* is that which is on each ſide the Equinoctial, bounded by the Tropicks of *Cancer* and *Capricorn*.

The two Temperate *Zones* are contained between each Tropick and the Polar Circles.

The two Frigid or Frozen *Zones*, are contained within each Polar Circle and their reſpective Poles.

The Diviſion of the Earthly Globe.

The *Globe* of the Earth is divided into four parts,

VIZ.

EVROPE, *AFRICA,*
ASIA, *AMERICA.*

EVROPE is bounded from *Aſia* by the *Mediterranean Sea*, on the Eaſt with the River *Tanais*, and on the Weſt with the Weſtern Ocean; and containeth theſe Provinces.

Germany,
Italy,
France,
Spain,
Denmark,
Norway,
Sweedland,
Muſcovy,
Poland,
Hungary,
Sclavony,
Greece.

The Principal Iſlands are,

Great Britain,
Ireland,
Candie,
Sicilly,
Sardinie,
Corſica,
Cyprus.

ASIA is bounded on the North with the Northern Ocean, and on the South with the Red-Sea, on the Eaſt with the Eaſt-Indian Ocean, and on the Weſt with the Flood *Tanais.*

The Principal Regions are,

Anatolia,
Syria,
Paleſtine,
Armenia,
Arabia,
Georgia,
Aſſyria,
Meſopotamia,
Chaldea,
Perſia,
Mogul,
Tartaria,
China,
India, and the Iſlands thereof.

AFRICA is bounded on the Eaſt with the Red Sea, on the Weſt with the *Atlantick* Ocean, on the South with the Southern Ocean, and on the North with the *Mediterranean* Sea.

The Provinces are,

Egypt,
Abyſſines,
Barbary,
Monomotapa,
Æthiopia,
Nubia.

The Principal Iſlands are,

Madagaſcar, or St. *Laurence,*
The *Canary* Iſlands,
St. *Thomas,*
The *Madera* Iſlands,
Cape de Verde Iſlands.

AMERICA is bounded on the Eaſt with the *Atlantick* Ocean, on the Weſt with the *Pacifick* South Sea, on the North without Bounds, and on the South with the *Magellanick Sea.*

It conſiſts of two Parts, *viz.* North and South *America.*

The

The Provinces of North *America* are,

New France,
New England,
Penſylvania,
New Jerſey,
Maryland,
Virginia,
Carolina,
Terra Florida,
Mexico or *New Spain*.

The Chief Iſlands are,

Iſeland,
Greenland,
California,
Hiſpaniola,
Cuba,
Porto-Rico,
Jamaica,
Barbadoes, and the reſt of the *Caribee* Iſlands.

The Provinces of South *America* are,

Brazil,
Terra Firma,
Chili,
Peru,
Amazones,
Paragua,
Magellanick-Lands.

One Iſland, *Terra del Fuego*.

The Names of the Seas in ſeveral Parts of the World.

Mar del Nort, *Narrow Sea*, *Mediterranean Sea*, *Mare Majore*, *Mare Pacificum*, *Mare Caſpium*, *Eaſt-Indian Sea*, *Perſian Sea*, *Red Sea*.

The Names, and Number of the Stars of each Conſtellation on the Celeſtial Globe.

Northern Conſtellations are 21, *viz.*

1	*Urſa Maior*,	7	6	*Corona Borealis*,	8
2	*Urſa Minor*,	27	7	*Engonaſes*, or *Hercules*,	29
3	*Draco*,	31	8	*Lyra*,	10
4	*Cepheus*,	11	9	*Olor*, or *Cygnus*,	17
5	*Bootes*,	22	10	*Caſſiopeia*,	13

11 *Per-*

11 *Perſeus,*	26	18 *Delphinus,*	10
12 *Auriga,*	14	19 *Equiculus,*	4
13 *Serpentarius,*	24	20 *Pegaſus,*	20
14 *Serpens,*	18	21 *Andromeda,*	23
15 *Sagitta,*	5	22 *Triangulum,*	4
16 *Aquila,*	9	23 *Coma Berenices.*	14
17 *Antinous,*	7		

Zodiack Conſtellations, 12, *viz.*

1 *Aries,*	13	7 *Libra,*	8
2 *Taurus,*	23	8 *Scorpio,*	21
3 *Gemini,*	18	9 *Sagittarius,*	31
4 *Cancer,*	9	10 *Capricornus,*	28
5 *Leo,*	27	11 *Aquarius,*	42
6 *Virgo,*	26	12 *Piſces.*	34

Southern Conſtellations, 27.

1 *Cetus,*	22	15 *Piſcis Auſtrius,*	11
2 *Orion,*	31	16 *Grus,*	13
3 *Flumen Eridanus,*	34	17 *Phœnix,*	15
4 *Lepus,*	12	18 *Indus,*	12
5 *Canis Major,*	18	19 *Pavo,*	20
6 *Canis Minor,* vel *Canicula,*	2	20 *Apus avis Indica,*	11
7 *Argo Navis,*	41	21 *Apis Muſca,*	4
8 *Hydra,*	25	22 *Chamelion,*	10
9 *Crater,*	7	23 *Triangulum Auſter,*	5
10 *Corvus,*	7	24 *Piſcis volans,*	7
11 *Centaurus,*	37	25 *Dorado,*	7
12 *Fera,* aut *Lupus,*	19	26 *Toucan,*	8
13 *Ara,*	7	27 *Hydrus.*	21
14 *Corona Auſt.*	10		

The Globes are compoſed of theſe Parts:

Firſt, *The Body, or Globe it ſelf.*
Second ly, *The Brazen-Meridian.*
Thirdly, *The Quadrant of Altitude.*
Fourthly, *The Hour-Circle and Index.*
Fifthly, *The Wooden Frame in which it is put,* called the *Horizon.*

The *Globe* doth repreſent the natural Situation and Poſition of the Earth and Heavens, and performs Problems of the Sphere, either in *Aſtronomy* or *Geography.*

1. The *Brazen-Meridian* is divided into 4 Parts or Quadrants, each being divided into 90°; within this Meridian the Body of the Globe turneth upon the Axis, being two ſtrong Wires.
2. The *Hour-Circle* is a flat Ring of Braſs, faſtened upon the North-part of the Meridian, and is divided into the 24 Hours of a natural Day; and each of theſe Hours is ſubdivided into Halves and Quarters.
3. The *Quadrant of Altitude* is a long and thin Slip of Braſs divided into 90°, and is to move up and down upon the Surface of the Globe to any Poſition required; and when placed in the *Zenith,* the Edg thereof repreſenteth an *Azimuth,* and the Diviſions ſhew the *Almicanters,* or Circles of Altitude.
4. The *Horizon* is a flat and round Frame of *Wood,* in which the *Brazen-Meridian,* and conſequently the whole Globe doth move, being divided into a *Kalendar,* ſhewing the Day of the Month, the Place of the Sun, the Rhombs, *&c.*

Problem I.

How to ſet the Globe to the Latitude of a Place.

Suppoſe you were to ſet the Globe to the Latitude of 52° North; the Globe being in the Frame, move the Meridian either higher or lower, until 52 doth cut the very edg of the Horizon on the North-ſide thereof, (the divided Side of the Brazen-Meridian being towards you) then the Meridian of the Globe being turned North and South, by the help of a

Magnetical Needle, it doth then repreſent the natural Situation of the Heaven or Earth upon the Celeſtial or Terreſtrial Globe.

The Uſe of the Terreſtrial Globe.

Problem II.

To find the Latitude of any Place upon the Globe.

Firſt, find the Place required upon the Globe, then turn the Globe about, until the Place whoſe Latitude is required be juſt under the ***Brazen-Meridian***; then note what Degree ſtands againſt it on the Meridian, that is the Latitude of the Place which was required.

Example.

Let it be required to find the Latitude of ***Rome*** : Turn the Body of the Globe about till ***Rome*** be juſt under the Braſs-Meridian, and you will ſee 42 to be right againſt it, which is the Latitude of ***Rome***.

Problem III.

To find the Longitude of any Place upon the Globe.

Turn the Body of the Globe about, till the Place whoſe Longitude you require, comes under the Meridian; then obſerve what Degree of the Equinoctial is cut by the Braſs-Meridian, and the Number of thoſe Degrees is the Longitude of the Place you ſeek for.

Example.

Let it be required to find the Longitude of ***Rome***, as before; therefore bring *Rome* under the Meridian, which being done, the Meridian will cut the Equinoctial in 36° $\frac{1}{2}$, the Longitude required.

Problem IV.

To find the Diſtance of any two Places upon the Globe.

To perform this, lay the beginning of the Degrees on the *Quadrant* of *Altitude* upon one of the Places required, and note how many Degrees there are contained between them; which is the Diſtance between the ſaid Places.

Example.

Let it be required to find the Diſtance between *London* and *Rome*; therefore lay the Quadrant of Altitude from one Place to another, and you will find 13° to be intercepted between the aforeſaid Places, which is the Diſtance between *London* and *Rome.*

Problem V.

To find the Poſition of Places one from another.

Firſt, ſet the Globe to the Latitude of one of the Places, and bring the ſame Place under the Meridian, and extend the Quadrant of Altitude, being fixed over the firſt Place, to the other Place, and the end of the Quadrant ſhall point out on the Horizon the Poſition that one Place hath from the other.

Example.

Let it be required to know the Poſition of *Rome* from *London*; therefore bring *London* under the Meridian, and there fit the Quadrant of Altitude, and lay the edg thereof upon *Rome*, and the end of the Quadrant of Altitude will point you to 53°, which is the Poſition of *Rome* from *London.*

The Uſe of the Celeſtial Globe.

Problem VI.

The Day of the Month being given, to find what Sign and Degree the Sun is in.

Firſt, find the Day of the Month in the Kalendar, on the Horizon, and right againſt it you ſhall find the Sign and Degree in which the Sun is.

Example.

Example.

Let it be required to find the Sun's Place on the fifth of *May*. You muſt find the fifth of *May* in the Kalendar, and right againſt it you will find 25 Degrees in *Taurus*, which is the Sun's Place that Day.

Problem VII.

How to place the Index of the Hour-Circle for any Day in the Year.

The Place of the Sun found (as in the laſt Propoſition) you muſt find that Degree on the Ecliptick-Line of the Globe, and bring that Degree to the Brazen-Meridian; then ſtaying the Globe there, turn about the Index of the Hour-Circle till it points juſt upon the upper Line of XII in the Hour-Circle; which being done, the Hour-Circle is rectified for that Day.

Problem VIII.

To find the Time of the Sun's Riſing and Setting.

The Hour-Circle being rectified, and the Globe ſet to the Latitude, then turn the Globe about till the Degree in which the Sun is, cut the Eaſt-ſide of the Horizon; and then caſting your Eye upon the Hour-Circle, the Index will ſhew you the Time of the Sun's Riſing: and the Globe being turned about till the Degree of the Sun cut the Weſt-ſide of the *Horizon*, the Index will ſhew you the Time of the Sun's Setting.

Example.

Let it be required to find the Sun's Riſing and Setting the fifth Day of *May*, in the Latitude of *London*, the Sun being then in 25° of *Taurus*.

Firſt, find the 25*th* deg. of *Taurus* in the Ecliptick Line, which being turned to the Eaſt-part of the Horizon, you will find the Index point to a quarter after four of the Clock; the ſame Point of the Ecliptick being turned to the Weſt-part of the Horizon, you will find the Hour-Index point to 3 quarters paſt 7, the Time of Sun-ſetting.

Having the Time of the Sun's Riſing and Setting, you may find the Length of the Day and Night; for the Time of the Sun's Riſing being doubled, gives the Length of the Night, and the Time of Sun-ſetting doubled, the Length of the Day.

4 1/4
8 1/2

7 3/4
7 3/4
15 : 1/2

15 : 1/2
8 : 1/2
24 : 0

Example.

Example.

The fifth of *May*, the Sun riſeth at 4 of the Clock and a quarter paſt, which being doubled, is 8 Hours and a half, the Length of the Night; and the Sun-ſetting, which is at 7 a Clock and three quarters, which being doubled, is 15 $\frac{1}{2}$ Hours, the Length of the Day.

Problem IX.

To find the Sun's Amplitude.

The Amplitude of the Sun is an Arch intercepted between the Eaſt or Weſt-points, and that part of the Horizon where the Sun riſeth or ſetteth.

The finding of the Amplitude differeth little from the laſt Propoſition: for having brought the Degree of the Sun's Place to the Horizon, you count how many Degrees of the Horizon are intercepted between the Eaſt or Weſt-point and that Part of the Horizon where the Sun either riſeth or ſettteth.

Example.

On the fifth of *May*, I deſire to know the Sun's Amplitude in the Latitude of *London*; therefore bring the Place of the Sun that Day to the Horizon, and you will find 31° $\frac{3}{4}$ intercepted between the Point of the Horizon and the Eaſt-point, which is the Sun's Amplitude Northerly.

Problem X.

How to find the Sun's Declination any Day of the Year.

The Declination of the Sun is an Arch of the Meridian, intercepted between the Sun's Place and the Equinoctial; to find which you muſt bring the Degree in which the Sun is to the Brazen-Meridian, and there ſtay it, and count how many Degrees of the Meridian are contained between the Equinoctial and the Sun's Place, and that is the Declination.

Example.

I would know what Declination the Sun hath the fifth of *May*, the

Sun being 25° in *Taurus*, which being brought to the Meridian, you will find 19° intercepted between that Point and the Equinoctial on the Brazen-Meridian, which is the Declination required.

Problem XI.

To find the Meridian Altitude of the Sun any Day of the Year.

The Meridian Altitude of the Sun is an Arch of the Meridian, intercepted between the Horizon, and the Degree in which the Sun is. To perform which, turn the Globe about till the Degree of the Sun be juſt under the Braſs-Meridian: then ſtaying the Globe there, count how many Degrees are contained between the Place of the Sun under the Meridian and the Horizon; and that is the Meridian-Altitude.

Example.

On the fifth of *May*, it is required to find the Meridian Altitude of the Sun that Day in the Latitude of *London*: the Sun's Place in the Ecliptick is 25° in *Taurus*; therefore bring that Degree under the Braſs Meridian, and you will find 57° $\frac{1}{2}$ to be intercepted upon the Braſs-Meridian between the Place of the Sun and the Horizon; that is the Meridian-Altitude of the Sun that Day.

Problem XII.

How to know what Altitude the Sun ſhall have any Hour of the Day on any Day of the Year.

Having found the Sun's Place, and rectified the Globe to the Latitude, and the Index of the Hour-Circle for the Day propoſed, turn the Globe about till the Index of the Hour-Circle be juſt upon the Time when you would know the Altitude; then ſtaying the Body of the Globe here, bring the Quadrant of Altitude, (being ſcrued on to the Zenith,) and lay it over the Sun's Place; Then the Number of the Degrees contained betwixt the Horizon and the Sun's Place, counted on the Quadrant of Altitude, is the Altitude of the Sun at that Hour.

Example.

Let the Time given be the tenth Day of *April*, in the Latitude of *London*, at which time (by the ſixth Propoſition) I find that the Sun is in the beginning of *Taurus*, and I would know what Altitude the Sun will have at nine of the Clock in the Morning: The Index of the Hour-Circle being rectified for that Day, turn the Body of the Globe about, till the Index of the Hour-Circle lies juſt upon 9 of the Clock; then ſtaying the Globe there, lay the Quadrant of Altitude on the Sun's Place, and the Number of Degrees between the Horizon and the Sun's Place (counted upon the Quadrant of Altitude) is the Height of the Sun, which here I find to be 36° at that time, or at three in the Afternoon; for the Sun hath the ſame Altitude (nearly) at 9, 8, 7, 6, *&c.* in the Morning, as it hath at 3, 4, 5, 6, *&c.* in the Evening.

Problem XIII.

How to find the Hour of the Day by the Globe.

This Propoſition cannot be performed conveniently by the Globe only, but the Altitude of the Sun muſt be firſt taken by ſome Inſtrument, and then this is but the Converſe of the former Propoſition, which it performs thus: The Globe being ſet to the Latitude, and the Index of the Hour-Circle rectified, turn the Globe about till the Degree of the Sun's Place meet with the Altitude, taken by the Inſtrument upon the Quadrant of Altitude, and then will the Index on the Hour-Circle ſhew you the Hour of the Day.

Problem XIV.

To find both the Right and Oblique Aſcenſion, and Oblique Deſcenſion of the Sun.

The Globe being ſet to your Latitude, bring the Degree of the Sun to the *Brazen-Meridian*, there ſtaying it; ſee what Degree of the *Equinoctial* is cut by the ſaid *Brazen-Meridian*, and that is the *Right-Aſcenſion* of the Sun that Day. So the Sun being in the beginning of *Taurus*, his *Right-Aſcenſion* will be found to be about 28°, and bringing the Sun's Place to the Eaſt-part of the *Horizon*, in the Lat. of *London*, the *Horizon* will cut the *Equinoctial* in 13° $\frac{1}{4}$, which is the Oblique Aſcenſion, and bringing the Sun's Place to the Weſt-part of the Horizon, the Horizon will cut the Equinoctial in 43°, the Oblique Deſcenſion.

Problem XV.

To find the Meridian Altitude of a Star, or the Altitude of a Star at any other Time.

To find the Meridian Altitude, let the Globe be ſet to your Latitude, and then turn the Body of the Globe about, till the Star be under the Brazen-Meridian, and then the Number of Degrees of the Meridian intercepted between the Star, and the North or South-part of the Horizon, according as the Star is ſituated, is the Meridian Altitude thereof.

Now to find the Altitude at any other Hour, turn about the Globe till the Index of the Hour-Circle be at the Hour you would know the Altitude of the Star, (the Index of the Hour-Circle being firſt rectified to the Sun's Place) and then apply the Quadrant of Altitude to the Star, and the Degrees of the Quadrant cut by the Star are the Altitude at that Time.

Problem XVI.

To know at any time of the Day or Night, what Stars be above the Horizon.

This is no other than to place the Globe in a true Poſition at that Time: Which is eaſily performed by turning the Globe (the Index firſt rectified to the Sun's Place) till the Hour-Index point to the Hour of the Day or Night; and ſtaying the Globe there, you will ſee all the Stars that are above the Horizon at that Time.

Problem XVII.

How to know the Riſing, Culminating, and Setting of any fixed Star; alſo what part of the Horizon he riſeth and ſetteth in.

Having rectified the Index of the Hour-Circle, and placed the Globe according to the Latitude, then bring the Star, whoſe Riſing, Culminating, or Setting you deſire, to the Eaſt-ſide of the Horizon; then will the Index of the Hour-Circle ſhew you the Time of his Riſing; then bring the ſame Star under the Brazen-Meridian, and there ſtaying the Globe, the Index will ſhew you at what Hour the ſaid Star culminates, and comes to the Meridian. Laſtly, bring the ſame Star to the Weſtern-part of the Horizon, and then the Index of the Hour-Circle will ſhew you at what hour the ſaid Star ſetteth, and by the Horizon you may know the Amplitude, as of the Sun.

Problem XVIII.

To find the Hour of the Night by the Globe.

You muſt take the Altitude of ſome known Star by a Quadrant, or other Inſtrument, and then having rectified the Index of your Hour-Circle according to the Day of the Month, turn the Globe about till you make the Star agree with the Altitude upon the Quadrant of Altitude to the Eaſtward or Weſtward of the Meridian, according to the Star's Poſition; then the Index of the Hour-Circle will point out to you the Hour of the Night.

SECT. VII.

A Short Appendix, ſhewing ſome ſecret Properties of the Loadſtone.

THe Nature, and ſtrange Properties of the *Loadſtone* are ſuch, that the more they are known, the more they are juſtly to be admired, in their lively expreſſing the infinite Power and Goodneſs of God, who hath created ſo precious a Jewel for the profitable uſe of Man; and for the enlarging and ſetting forth of his own Glory, eſpecially in that Aſſiſtance it affords to Man, in the Diſcovery of the whole Univerſe, which is the Work of his Hands, and his mighty Wonders in the deep Waters; the Properties not only ſerving for Maritime Affairs, but alſo in travelling by Land in vaſt and ſolitary Deſarts; for moveable Sun-Dials in all Places of the World; for the more ready and exact Chorography of any Country, or true plotting of any Ground, and for following of any Mineral Vein (void of Iron) under the Earth; and alſo for Coal-Mines, with ſeveral other neceſſary Uſes; retaining in it ſelf, as it were, the Mirror of Philoſophy, manifeſted by its Sympathetical Coition, and Antipathetical Repulſion, with many other occult Operations very admirable to behold; two eſpecially that are treaſured up in its dusky Entrails, one of Attraction, the other of Direction: it hath Subſtance, Virtue, and Operation, ſerving to many good Purpoſes: therefore this Stone of all others may be accounted the moſt precious, wherein the Majeſty of Nature doth moſt appear; which admirable Treaſure God hath vouchſafed to reveal unto the weak Knowledg of Man towards the end of the World, being ſo plain to the meaneſt Capacity, and that out of a baſe contemptible Stone, as it ſeemeth to be, and yet filled with ſuch excellent and wonderful Virtue, that all the Gems in the World have not the like.

Of the Name of the Stone, and of the Colour, and from whence it comes, and how it was firſt found.

This Stone is called *Magnes*, uſed under that promiſcuous Appellation both by the *Greeks* and *Latins*; and as *Lucretius* writeth, the Name is derived from the Country *Magneſia.*

> *The* Greeks *do call it* Magnes *from the Place.*
> *For that the* Magnets *Land it doth imbrace.*

Plato ſaith, ſome call it *Lapis Heraclius*, from the Name of *Heraclea*, a City of *Lydia*, where it was firſt diſcovered; and upon the ſame account the Touchſtone is called *Lapis Lydia.*

Theophraſtus, in his *Book of Stones*, for the ſame reaſon calleth it *Herculeum.*

Nicander thinks the Stone ſo called, and ſo doth *Pliny* from him, from one *Magnes* a Shepherd; for it is reported that he found it by his Hobnail'd Shoes, and his Shepherd's Crook that ſtuck to it, when he fed his Flocks in *India.*

Others call it *Siderites*, from σίδηρος which ſignifies *Iron.* By us it is called a *Loadſtone*, alluding to the two Stars in the Tail of the Celeſtial Bear, which were antiently called Load-Stars, or Leading-Stars; and therefore this Stone bears that Appellation, which now performs the ſame Office.

This Magnet, or Loadſtone, is found in divers parts of the World, and moſt commonly in Iron Mines, and by ſome ſuppoſed to be of the Iron Oar.

Of theſe there are divers ſorts, different each from other, as well in Goodneſs, as in Colour, Weight and Force, but not in Property, (altho many have judged the Cauſe of the Variation of the Needle to be according to the Diſtance of the Mine from whence the Stone was taken, and the Place where it is uſed, but there is no ſuch thing) for all Stones ſoever have one Direction.

The firſt and beſt ſort of theſe Stones come out of *Eaſt-India*, from the Coaſt of *China* and *Bengala*, and are of the colour of Iron, or Sanguine colour: Theſe Stones are maſſy and weighty, and will draw or lift up the juſt weight of themſelves in Iron or Steel, and ſome five times, ten times, and twenty times their own weight; and theſe are of the fineſt ſort, and are commonly ſold for their Weight in Silver in the *Eaſt-Indies* where they grow, becauſe the beſt or fineſt are very rare to be found; for it is commonly an entire Stone, lying in the Earth by it ſelf, and no piece or part of any other.

There is alſo another ſort, of a reddiſh colour, found in *Arabia*, and the Red-Sea, growing broad and flat, much like unto a Tile of a Chimney-Hearth: Theſe are not ſo weighty as thoſe of *China*, but are very near as good, and the Virtue continueth long on the Compaſs or Needle that is touched upon theſe Stones.

There are of theſe Stones likewiſe in the *Levant*, near a Town called *Porta Feraro*, and are called there *Calamita Preta*, that is to ſay, the *Black Magnet*; becauſe there is another ſort that is white and light, like unto a piece of dry Fullers Clay, and are called *Calamita Blanca*. Theſe black Stones are mingled with white Veins: they are of no great Force, nor their Virtue of long continuance.

Alſo there are of theſe Stones in *High-Germany*, that are full of Holes like a Honey-Comb, and lighter than the other, but better than they; theſe are of an Iron colour.

Another ſort there are in *Norway*, in the Iron Mines, as in *Long-Sound*, and other Places; their Colour is black, mixt with gray; theſe are alſo of an indifferent force.

There are alſo ſome in the Mines of *Carraca* and *Cantabria* in *Spain*; and ſome there are found in the Weſt of *England*.

There are ſome found alſo in *Bohemia*, and ſeveral other Places.

All theſe Stones are different one from another, as well in Force, as in Colour and Weight, yet all of one Operation in the Needle, ſhewing all one Point of Direction: which is a moſt wonderful and admirable Providence of God to cauſe it ſo to be; for infinite would the Diſtractions be, if it were otherwiſe in the practical Uſe of the Compaſs: For true it is, that God is mighty and marvellous in all his Works; and truly his Power is greatly ſhewn in this wonderful Miracle of Nature, as in any Stone in the whole Creation.

Of the Attractive Virtue of the Loadſtone.

That this Stone hath an attractive Operation, is apparently manifeſt; for if you apply a piece of Iron unto either of the Poles, it will there hold it, and at a diſtance will alſo draw or attract a ſmall piece of Iron, according to the Vigor or Imbecillity of the Stone; but what Strength ſoever it hath, it may be artificially improved to be greater than can by it ſelf be diſcovered: which is to be performed by applying a ſmooth and bright piece of Iron to either Pole of the Stone, and it will immediately deliver its Virtue unto it. The Virtue being herein contracted in this piece of Iron, the Stone doth manifeſt it ſelf to have ten times more Strength; for this Cauſe therefore are Loadſtones capped with Iron, for the artificial Augmentation of their Strength.

And this Virtue is freely communicated from it ſelf to any thing elſe that is capable of its Reception; ſo that a piece of Steel having received Strength from the Stone, that will alſo attract another piece of Steel in proportion to that Virtue it hath received.

This Experiment I have often tried upon my Loadſtone; for by touching of a Knife upon it, it will take up a Key of two ounces weight; and that within the Sphere of the Stone it ſhall deliver the Virtue into a piece of Iron, and not touch the Stone at all; and likewiſe over the Stone, it ſhall cauſe one piece of Iron to hang to another: So wonderful is the attractive Quality of this Stone, manifeſted in theſe and the like Experiments.

Of the Sympathetical and Antipathetical Property of the Loadſtone.

When a Needle is touched upon a Loadſtone, the North and South-ends of this Needle will apply themſelves reſpectively to thoſe Poles from whence they received their Magnetical Life, to wit, the North-end of the Needle will fly to the North-end of the Stone, and the South-end of the Needle to the South-end of the Stone; which denotes their mutual Sympathy; but putting the North-end of the Stone to the South-end of the Needle, when it is upon a Pin, the South-end of the Needle will immediately fly away; and if you put the South-end of the Stone to the North-end of the Needle, it will alſo diſcover its Antipathetical Nature, and fly away from it.

But a contrary Operation there is yet in the two Needles to that of the Loadſtone; for if one of the Needles being hung upon a Pin, and you apply the North-end of one Needle to the North-end of that upon the Pin, it ſhall immediately fly away; which denoteth a contrary Operation in the Needle to that of the Loadſtone, and the South-end of one will immediately come to the North-end of the other.

The ſame Property of Sympathetical Coition, and Antipathetical Repulſion, is alſo diſcovered by two Loadſtones, floating in two little Boats in a great Baſon of Water, the two Poles of either Stone being diſpoſed parallel to the Plain of the Horizon; and if you put both the South-Poles together, they ſhall avoid the Contact of one another by a natural Antipathy; but if the North-Pole of the one be direct to the South-Pole of the other, they will immediately manifeſt their natural Sympathy one to another, and will cleave together by a ſtrong Attraction.

This is alſo apparently evident between the great Magnet the Earth, and a Loadſtone; for if you put a Loadſtone into a ſmall String, and let it hang in the Air, or elſe to float in the Water in a Wooden Diſh, and putting the North-end of the ſmall Magnet towards the North-end of the great Magnet the Earth, it ſhall immediately change its Poſition, and turn its North-Pole towards the South-Pole of the ſaid great Magnet. The ſame Experiment is alſo found with Magnetical Needles, or Mariners Cmopaſſes, being placed near together, the North-point of one will draw the South-point of the other, and ſo will ſtand North to South *ad Infinitum*.

Of the Conſequences that follow the various dividing and cutting of the Loadſtone.

IF a Loadſtone be confuſedly broken by Violence into many Pieces, each of the Pieces ſhall be an entire Loadſtone, having both its Poles diſtinctly of it ſelf, with all the other Properties that were in the Stone before it was broken.

But if a Loadſtone be divided in the midſt between the two Poles, in the Equinoctial, then it is abſolutely two entire Loadſtones; and thoſe Parts which were the Equinoctials before, are now become two Poles, and the two Poles that were Poles before, do continue the ſame.

But if a Stone be cut Meridionally quite through the two Poles, ſo that one Axis is now converted into two, and each of them remove into each Stone, ſo that it is alſo become two entire Loadſtones, the *Axis* of either of them will retire into the gravity of either piece; and if you join theſe two pieees together again, the two *Axes* will again become one, which is moſt admirable to behold.

But if you cut off a piece of the Stone at the very Pole, in a parallel Section, the Virtue of that Piece will immediately retire from it unto the main Stone, and will ſcarcely have any Virtue at all therein; but applying this ſmall Piece that was cut off, to the ſame Place again, the Stone will forthwith impart the ſame Virtue as was before, into this Piece ſo cut off, ſo long as it doth abide in that Place: but when it is removed, it doth again recal its Virtue from the ſaid Piece. This I have experienced in a Stone of a very conſiderable Price.

And in the ſame manner, if you apply a weak Stone to the Poles of a ſtrong one, the ſtrong Stone will impart of its Virtue to the weak Stone, making it to be as ſtrong as it ſelf, ſo long as it is its Neighbour; but when this weak Magnet deſerts this neighbourly Propinquity, the ſtrong Magnet will draw its Virtue to it ſelf again, and will truſt it no further than the Power of its recal.

To find the Poles of a Stone.

THere are ſeveral Ways for the Performance of this Experiment.

Firſt, you may have a thin piece of Steel about an Inch in length, and $\frac{1}{8}$ of an Inch broad; this piece of thin Steel being bent circular, and laid on the Stone, will immediately lie parallel to the *Axis* of the Stone, and direct which way the Poles do lie. Which being diſcovered near where they lie, you may find them more exactly by a ſmall piece of a ſewing Needle; which being laid on the Stone, if it be near either of the Poles, will elevate one end thereof; then move it farther and farther, till it doth erect it ſelf perpendicular, and that very Point will be the Pole of the Stone.

Now to know which Pole it is, you may apply a ſmall Needle of a Dial to it, and if the Pole draw the North-end of the Needle, then is that the North-Pole of the Stone; and the contrary.

Or otherwiſe, you may find the Pole by a ſewing Needle and Thread, by hanging it over the Stone where you ſuppoſe the Pole to be, and keep it a little ſhort from the Stone, and the end of the Needle will directly point to the Pole of the Stone.

Whether Onions or Garlick do obſtruct the Operation of the Loadſtone?

THere is a common received Opinion, That if the Loadſtone be rubbed over with Garlick or Onions, that it will obſtruct the Virtue thereof; or if a Knife being touched upon the Loadſtone, and afterwards cut an Onion or Garlick therewith, that it will immediately loſe its Virtue.

This Conceit hath alſo been countenanced by the Antients; but if you are pleaſed to make trial of it, you will find it to be but a meer Fallacy.

It is alſo as falſe, that the Diamond doth hinder the Virtue of the Loadſtone, while it is near it.

A delightful Experiment performed by the Loadſtone, repreſenting the Engaging of two Armies in Battel.

FOr the performance hereof, you muſt have a Braſs or Pewter Plate, and upon this Plate put ſeveral little Heaps of the Filings of Iron, with ſome ſhort Bits of Sewing-Needles, and put them in order of a Battel, one main Body againſt another, alſo with their right and left Wings, and their Forlorn-hopes; this being done, bring the Loadſtone under the Plate with one of the Poles upward, and put it firſt toward one of the right Wings of the Army, and they will immediately receive an Alarm, and as it were ſtand to their Arms; then move the Stone toward the other Wing of the Enemy, and they alſo will receive the like Alarm; and then by moving the Stone to and fro under the Plate, you will put both Parties into a Motion, in a Charging Poſture, and one to charge the other in a deſperate Engagement, and one to come within the other; and ſo you may at laſt engage the main Bodies of the Army; and there you may ſee that ſometimes they are Conquerors, and ſometimes conquered, which is cauſed by the Motion of the Stone with your Hand under the Plate; and the ſhort Bits of the Needles may repreſent their Generals and Commanders, which will be very full of Action, where you may ſee ſometimes that there will be 20 or more of the Common Souldiers to fall foul of the ſaid Commanders: And if between theſe Armies you put ſmall Breaſt-works and Trenches made with Sand, and Filings put in the Trenches, you will then have repreſented the ſudden riſing of them one againſt another, as if they lay in Ambuſh, waiting for an Opportunity againſt their Enemies.

To make a Sewing-Needle ſwim upon the Surface of the Water, and to play up and down like a Fiſh, and to find out the Magnetical Meridian.

TAke a ſmall Sewing-Needle, and touch the two Ends thereof upon the two Poles of the Stone; and having a Glaſs of Water before you, take the Needle very lightly between your Finger and Thumb, and lay it lightly on the Surface of the Water, ſo that it break not through, and there it will lie; then take a Knife that hath been touched with the Loadſtone, and bring it to and fro upon the edg of the Glaſs, and

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the Needle will follow it up and down, and will play up and down on the Superficies of the Water like a Fiſh; and then take away the Knife, and the Needle will immediately poſit it ſelf to the Meridian, pointing due North and South.

Such an inferiour Inſtrument as this may ſtand Men in great ſtead in time of great Straits and Exigencies, if they ſhould be at Sea, and their Compaſſes be taken from them; for if you put a Needle, being touch'd, through a ſmall piece of Cork, it will then perform this Effect exceeding well in all Storms and Tempeſts whatſoever, being born up by the Cork on the top of the Water, and the Poſition thereof will be continually in the Magnetical Meridian.

To infuſe Magnetical Virtue into a Needle, without the help of a Loadſtone.

IRon being a Mineral of the Earth, and having a Sympathetical Quality with the Loadſtone, acquiring this Verticity from the Magnetiſm of the Earth, being diſpenſed according to the various Poſitions thereof; for all Iron, whoſe Poſition is parallel to the *Axis* of the World, or if it be perpendicular to the Horizon, the upper-part thereof ſhall have North, and the lower-part South-Virtue; as Bars in Windows, Caſements, Tongs and Fire-Forks, and all ſuch things, *&c.* And according to the Length of the Time of the Poſition of any ſuch piece of Iron, the ſtronger Virtue it doth contract: So that I once made Experiment upon a ſmooth piece of Iron, which had for ſeveral Years been in a perpendicular Poſture, and I filed the upper-end thereof bright, and touched a ſmall new Needle thereon, the South-end I touched upon the North or upper-part of the Iron, and the North-end upon the South or lower-end; and I found the Needle to play indifferently well, and to conform it ſelf to the Magnetical Meridian.

The Reaſon of this is from the Nature of the Iron, it being a Metal deducted out of the Loadſtone, or out of a Mine of that kind; the beſt Iron Mine and Loadſtone is the ſame thing; for it being placed artificially in the Air, or upon the Water, moveth North and South, attracteth other Iron unto it, and performeth the ſame Concluſions as the Magnet it ſelf.

A delightful Experiment performed with two Sewing-Needles, being touched upon the Loadſtone.

IF you touch two Sewing-Needles contrary one to the other, that is to ſay, the Point of the one Northerly, and the Point of the other Southerly, and put them into two ſmall pieces of Cork, and put them thus in a Baſon of Water, one at the one ſide, and the other at the other ſide of the Baſon, you ſhall ſee them as it were quickened with a vital Spirit, even ſo to move one towards the other, at the firſt fair and ſoftly; but when they draw near, they will ruſh together with great Violence, the Point of the one ſtriking preciſely at the Point of the other. You muſt place the Needle that is touched from the North, on the South-ſide of the Baſon, and the other on the other ſide, otherwiſe the Heads and not the Points will run together.

Of Cementing and Piecing of Loadſtones.

IF a Loadſtone chance to be broken, it will not at all be detrimental to the Virtue of the Stone, provided that they be joined together in the ſame Place where they were broken off, which may be ſet together very ſtrongly, by the help of a Cement prepared for that purpoſe, which is thus made:

Take the fine Pouder of *Loadſtone*, and half ſo much Pouder of *Brick*, made very ſmall, one part of *Burgundy-Pitch*, half ſo much *Roſin*, and a ſmall Portion of unwrought *Wax*; mingle theſe over a ſoft Fire, and heat the two pieces of the *Loadſtone* very hot; then take of this Cement, while it is hot, and lay it on very thin upon the two pieces, and then join them together very hard, and as cloſe as you can, and let it ſo ſtand until it be cold; and you ſhall have it fully as ſtrong as if it were an entire Stone, and not to be ſevered but by a great Fire.

Here follow ſeveral neceſſary TABLES, *with their Uſe and Application in the* Art of Navigation.

A Table of the Moon's Age for the Year 1695.

M.		D.	H.	M.	M.		D.	H.	M.
January.	New moon.	04	15	05	*July.*	Firſt quart.	08	20	20
	Firſt quart.	11	14	59		Full moon.	15	13	10
	Full moon.	19	17	41		Laſt quart.	22	08	42
	Laſt quart.	27	13	23		New moon.	30	10	52
February.	New moon.	03	01	52	*August.*	Firſt quart.	07	06	20
	Firſt quart.	10	09	40		Full moon.	13	20	33
	Full moon.	18	12	13		Laſt quart.	20	23	10
	Laſt quart.	25	20	01		New moon.	29	02	13
March.	New moon.	04	13	21	*September.*	Firſt quart.	05	14	05
	Firſt quart.	12	05	03		Full moon.	12	05	30
	Full Moon.	20	02	50		Laſt quart.	19	16	30
	Laſt quart.	27	01	46		New moon.	27	16	55
April.	New moon.	03	01	41	*October.*	Firſt quart.	04	09	26
	Firſt quart.	10	23	46		Full moon.	11	16	45
	Full moon.	18	13	57		Laſt quart.	19	11	56
	Laſt quart.	25	07	11		New moon.	27	06	57
May.	New moon.	02	14	59	*November.*	Firſt quart.	03	03	10
	Firſt quart.	10	16	54		Full moon.	10	07	00
	Full moon.	17	23	08		Laſt quart.	18	10	37
	Laſt quart.	24	12	53		New moon.	25	16	07
June.	New moon.	01	04	56	*December.*	Firſt quart.	02	11	12
	Firſt quart.	09	07	56		Full moon.	09	23	59
	Full moon.	16	06	17		Laſt quart.	18	04	25
	Laſt quart.	22	21	26		New moon.	25	06	11
	New moon.	30	19	41		Firſt quart.	31	21	43

In this Year are four Eclipſes, two of the Sun, and two of the Moon.

The Firſt is of the Moon, on *May* 18. about our ten a Clock. The Second of the Sun, *June* the 1*ſt*. about Five a Clock at Night. The Third of the Moon, *November* 10. at Eight a Clock in the Evening; if the Air be clear, will be ſeen of us; one third Part of the Moon's Body will loſe its Light. The Fourth of the Sun, a total Eclipſe, *November* 26. about Seven a Clock in the Morning, not ſeen of us.

A Table of the Moon's Age for the Year 1696.

M.		D.	H.	M.
January.	Full moon.	08	18	36
	Laſt quart.	16	21	59
	New moon.	27	17	36
	Firſt quart.	30	11	49
February.	Full moon.	07	14	10
	Laſt quart.	15	12	21
	New moon.	21	03	20
	Firſt quart.	28	03	43
March.	Full moon.	08	07	51
	Laſt quart.	15	22	25
	New moon.	22	12	59
	Firſt quart.	29	21	22
April.	Full moon.	06	23	10
	Laſt quart.	14	05	42
	New moon.	20	23	00
	Firſt quart.	28	14	41
May.	Full moon.	06	11	45
	Laſt quart.	13	10	33
	New moon.	20	09	52
	Firſt quart.	28	08	12
June.	Full moon.	04	21	48
	Laſt quart.	11	14	42
	New moon.	18	22	32
	Firſt quart.	27	00	08

M.		D.	H.	M.
July.	Full Moon.	04	06	56
	Laſt quart.	10	19	54
	New moon.	18	11	52
	Firſt quart.	26	14	56
Auguſt.	Full moon.	02	19	35
	Laſt quart.	09	02	36
	New moon.	17	03	10
	Firſt quart.	25	04	15
	Full moon.	31	21	21
September.	Laſt quart.	07	17	17
	New moon.	15	19	46
	Firſt quart.	23	15	29
	Full moon.	30	05	52
October.	Laſt quart.	07	09	23
	New moon.	15	11	36
	Firſt quart.	23	00	52
	Full moon.	29	16	30
November.	Laſt quart.	06	04	31
	New moon.	14	05	12
	Firſt quart.	21	08	16
	Full moon.	28	05	22
December.	Laſt quart.	06	00	42
	New moon.	13	20	04
	Firſt quart.	20	15	49
	Full moon.	27	20	49

Four Eclipſes this Year, two of the Moon, both viſible to us.

The firſt will be on *May* the 6th, about Midnight. The ſecond will be on the 30th of *October*, about 4 in the Morning; a total Eclipſe.

There will be two of the *Sun*, but both inviſible to us.

M.		D.	H.	M.
January.	Laſt quart.	04	22	28
	New moon.	12	08	59
	Firſt quart.	19	00	01
	Full moon.	26	13	53
February.	Laſt quart.	03	17	43
	New moon.	10	21	34
	Firſt quart.	17	10	30
	Full moon.	25	08	10
March.	Laſt quart.	05	10	20
	New moon.	12	05	14
	Firſt quart.	18	23	24
	Full moon.	27	01	23
April.	Laſt quart.	03	23	00
	New moon.	10	13	32
	Firſt quart.	17	13	52
	Full moon.	25	17	27
May.	Laſt quart.	03	07	46
	New moon.	09	21	39
	Firſt quart.	17	05	37
	Full moon.	25	07	13
June.	Laſt quart.	01	11	10
	New moon.	08	06	36
	Firſt quart.	15	22	16
	Full moon.	23	18	59
	Laſt quart.	30	17	02

M.		D.	H.	M.
July.	New moon.	07	16	58
	Firſt quart.	15	15	02
	Full moon.	23	05	01
	Laſt quart.	29	21	10
Auguſt.	New moon.	06	05	27
	Firſt quart.	14	08	02
	Full moon.	21	13	54
	Laſt quart,	28	03	48
September.	New moon.	04	20	17
	Firſt quart.	12	23	56
	Full moon.	19	22	10
	Laſt quart.	26	14	06
October.	New moon.	04	13	07
	Firſt quart.	12	14	40
	Full moon.	19	07	44
	Laſt quart.	26	14	48
November.	New moon.	03	07	46
	Firſt quart.	11	03	13
	Full moon.	17	17	51
	Laſt quart.	24	22	14
December.	New moon.	03	02	00
	Firſt quart.	10	13	25
	Full moon.	17	05	31
	Laſt quart.	24	18	04

In this Year will be three Eclipſes, one of the Sun, and two of the Moon.

The Firſt of the Sun *May* 11, about 1 in the Morning, inviſible to us The Second of the Moon, on the *26th* of *May*, about Eight in the Morning. The Third of the Moon, *October* the *19th*, about our Eight a Clock at Night; a viſible and almoſt total Eclipſe.

A Table of the Moon's Age for the Year 1698.

M.		D.	H.	M.
January.	New moon.	01	20	48
	Firſt quart.	08	21	24
	Full moon.	15	19	07
	Laſt quart.	23	15	26
	New moon.	31	13	16
Febr.	Firſt quart.	07	04	22
	Full moon.	14	10	02
	Laſt quart.	22	11	03
March.	New moon.	01	19	03
	Firſt quart.	08	12	04
	Full moon.	16	04	01
	Laſt quart.	24	05	20
	New moon.	31	08	14
April.	Firſt quart.	06	22	08
	Full moon.	14	18	19
	Laſt quart.	22	19	55
	New moon.	29	14	14
May.	Firſt quart.	06	08	24
	Full moon.	14	09	15
	Laſt quart.	22	07	11
	New moon.	28	21	10
June.	Firſt quart.	06	17	32
	Full moon.	13	00	40
	Laſt quart.	20	14	29
	New moon.	27	04	58
July.	Firſt quart.	04	12	55
	Full moon.	12	14	02
	Laſt quart.	19	20	36
	New moon.	26	13	51
August.	Firſt quart.	03	05	40
	Full moon.	11	02	25
	Laſt quart.	18	00	25
	New moon.	25	00	52
September.	Firſt quart.	01	19	36
	Full moon.	09	13	30
	Laſt quart.	16	05	01
	New moon.	23	14	20
October.	Firſt quart.	01	17	53
	Full moon.	09	00	02
	Laſt quart.	15	14	03
	New moon.	23	07	24
	Firſt quart.	31	11	26
November.	Full moon.	07	09	59
	Laſt quart.	14	02	03
	New moon.	22	02	10
	Firſt quart.	30	03	16
December.	Full moon.	06	19	54
	Laſt quart.	13	17	48
	New moon.	21	21	37
	Firſt quart.	29	16	00

Two Eclipſes of the Sun.

The firſt on the 31*ſt* of *March*, about Sun-ſetting, not ſeen of us. The ſecond on the 24*th* of *September*, near 4 a Clock in the Morning; a great Eclipſe, but Inviſible to us.

A Table of the Moon's Age for the Year 1699.

M.		D.	H.	M.
January.	Full moon.	05	06	59
	Laſt quart.	12	12	10
	New moon.	20	15	58
	Firſt quart.	28	02	20
Febr.	Full moon.	03	14	49
	Laſt quart.	11	07	58
	New moon.	19	07	52
	Firſt quart.	26	09	42
March.	Full moon.	05	07	14
	Laſt quart.	13	03	45
	New moon.	20	20	54
	Firſt quart.	27	15	13
April.	Full moon.	03	20	50
	Laſt quart.	11	21	44
	New moon.	19	06	46
	Firſt quart.	25	01	04
May.	Full moon.	03	11	13
	Laſt quart.	11	14	10
	New moon.	18	14	43
	Firſt quart.	25	05	07
June.	Full moon.	02	00	12
	Laſt quart.	10	03	16
	New moon.	16	21	32
	Firſt quart.	23	11	45

M.		D.	H.	M.
July.	Full moon.	01	17	22
	Laſt quart.	09	14	27
	New moon.	16	04	38
	Firſt quart.	23	04	53
	Full moon.	31	07	52
Auguſt.	Laſt quart.	07	22	10
	New moon.	14	12	32
	Firſt quart.	21	20	49
	Full moon.	29	22	22
September.	Laſt quart.	06	04	15
	New moon.	12	22	29
	Firſt quart.	20	15	04
	Full moon.	28	14	10
October.	Laſt quart.	05	09	47
	New moon.	12	10	41
	Firſt quart.	20	10	43
	Full-moon.	28	00	26
November.	Laſt quart.	03	08	26
	New moon.	11	02	43
	Firſt quart.	19	06	37
	Full moon.	26	12	03
December.	Laſt quart.	02	20	11
	New moon.	10	20	51
	Firſt quart.	19	00	56
	Full moon.	25	22	58

Four Eclipſes, two of the Sun, and two of the Moon.

The Firſt of the Moon, the 5th of *March*, at our 8 a Clock at Night, 10 parts of the Moon's Body will be darkned. The Second will be of the Sun, on the 21*ſt* about our 8 a Clock in the Morning; it will be a ſmall Eclipſe, and ſcarcely viſible to us. The Third will be an Eclipſe of the Moon, on the 30th of *Auguſt*, near our Noon, and will therefore be inviſible to us, but will be total and viſible to our *Anti-podes*. The Fourth will be of the Sun, on the 13th of *September* about 11 of the lock in the Forenoon; 10 Digits of the Sun's Body will be darkned.

A Table of the Moon's Age for the Year 1700.

M.		D.	H.	M.
January.	Laſt quart.	01	15	27
	New moon.	09	16	26
	Firſt quart.	17	14	03
	Full moon.	24	09	04
	Laſt quart.	31	07	14
Februar.	New moon.	08	11	31
	Firſt quart.	16	05	09
	Full moon.	22	19	11
March.	Laſt quart.	02	00	50
	New moon.	10	04	18
	Firſt quart.	17	13	34
	Full moon.	24	05	39
	Laſt quart.	31	19	33
April.	New moon.	08	18	18
	Firſt quart.	15	19	03
	Full moon.	22	15	00
	Laſt quart.	30	13	22
May.	New moon.	08	05	32
	Firſt quart.	14	23	22
	Full moon.	21	05	06
	Laſt quart.	30	06	06
June.	New moon.	06	14	26
	Firſt quart.	13	04	34
	Full moon.	20	18	25
	Laſt quart.	28	21	10
July.	New moon.	05	21	42
	Firſt quart.	12	12	13
	Full moon.	20	09	02
	Laſt quart.	28	11	00
Auguſt.	New moon.	04	05	07
	Firſt quart.	10	23	10
	Full moon.	19	00	42
	Laſt quart.	26	22	02
September.	New moon.	02	12	54
	Firſt quart.	09	13	33
	Full moon.	17	16	48
	Laſt quart.	25	04	20
October.	New moon.	01	21	56
	Firſt quart.	09	07	12
	Full moon.	17	08	54
	Laſt quart.	24	15	45
	New moon.	31	09	36
November.	Firſt quart.	08	03	10
	Full moon.	16	00	00
	Laſt quart.	22	21	33
	New moon.	29	23	50
December.	Firſt quart.	07	23	44
	Full moon.	15	13	06
	Laſt quart.	22	09	00
	New moon	29	18	00

Two Eclipſes, of the Moon only.

The firſt on the 23*d* of *Febrnary*, about 6 a Clock in the Morning; it will be viſible and total in our Weſtern Horizon.

The ſecond on the 18*th* of *Auguſt*; it will be a great Eclipſe, but inviſible to us.

The Explanation and Uſe of the preceding Table of the Moon's Age.

IN the ſaid Table, the one half Page contains the firſt ſix Months of the Year, the other half the following ſix Months: in the firſt Column of each half, towards the left hand, are the Months; in the ſecond, the New, Full, and Quarters of the Moon: in the three following Columns are the Days, Hours and Minutes of the ſaid New, Full and Quarters; which time is accounted from Noon to Noon. At the bottom of the Tables are the Eclipſes for the reſpective Years.

Uſe of the Table.

The Uſe of this Table is readily by Inſpection to find the Day, Hour and Minute of the New, Full and Quarters of the Moon.

Example 1.

Suppoſe it were deſired to find the time of New Moon in *Jan.* 1695.

Firſt, Look for the Year 1695, on the top of the Leaf; which having found, look for *January* on the firſt Column toward the left-hand; then in the next Column, in the ſame Month, is found New Moon; and in the three following Columns againſt New Moon, ſtands 04, 15, 05, which ſhews that the New Moon in *January* 1695, is the 4*th* day, 15 hours, 05 minutes Afternoon. The ſame Directions and Conſiderations ſerve for the Full Moon, or firſt and laſt Quarters.

Note, That when the Moon is in the firſt Quarter, it is 8 days old, at the Full 15 days, and in the laſt Quarter 22 days. Suppoſe therefore it were required to find the Moon's Age on *May* the 4*th*.

Looking in the Year 1695, the Table gives the New Moon to be on the 2*d* day; therefore it appears the Moon is 2 days old on the ſaid 4*th* of *May*.

Example 2.

Suppoſe it were required to find the Moon's Age on the 17*th* of *Auguſt*, 1695.

Looking in the Year 1695, in the Month of *Auguſt*, I find the Moon to be at the Full on the 13*th* day (that is, 15 days old); then the day for which I would find its Age, being 4 days after the 15*th* day, 15 and 4 making 19, I conclude the Moon to be 19 days old on the ſaid 17*th* day of *Auguſt*, 1695.

A Table of the Tides on the Sea-Coaſts of Great-Britain, Ireland, Norway, Holland, Flanders, France, Biſcay, *&c. Shewing what Moon makes full Sea in each of theſe Places, at every Day of the Moon's Age, after the Full or Change.*

The Deſcription and Uſe of the Tables.

First, you are to underſtand, that in the firſt Column of the Table is the Age of the Moon after her Full and Change; and the ſecond and third Columns ſhew the Hour and Minute of Full-Sea at each reſpective Place mentioned in the ſaid Tables; and the fourth Column ſheweth the Names of the ſaid Places; and the fifth ſheweth the Setting of the Tides upon the ſame Point of the Compaſs expreſt in the Title. And alſo in the Title you have the Hour when the Moon cometh upon each Point of the Compaſs, at Full and Change. The Uſe of which Tables ſhall be further illuſtrated by this following

Example.

Suppoſe you would know what Moon makes Full Sea at ***Dartmouth*** and *Torbay*, and at what Hour it cometh to ſuch a Point of the Compaſs, and the time of High-Water any Day of the Moon's Age.

Firſt, Look for *Torbay* or *Dartmouth*, which you will find under the Title of *Eaſt by North*, and *Weſt by South*, which doth ſhew, that at the Full and Change of the Moon ſhe cometh on that Point of the Compaſs at 5 hours 15 minutes, and then it is Full-Sea in the fore-mentioned Places.

So likewiſe if it be demanded, What time it will be Full-Sea when the Moon is ſix days after the Full or Change? Therefore look in the firſt Column for 6, and right againſt it, in the ſecond and third Columns, you will find 10 of the Clock, and 3 minutes paſt, which is the Time of Full-Sea in the fore-mentioned Places, at that Day of the Moon's Age.

North and South.

D.	H.	M.
0	12	00
1	12	48
2	01	36
3	02	24
4	03	12
5	04	00
6	04	48
7	05	36
8	06	24
9	07	12
10	08	00
11	08	48
12	09	36
13	10	24
14	11	12
15	12	00

12 *Hours,* 00 *Minutes.*

In the Road of *Gibralter.* On the Coaſt of *Flanders.* At the *North-foreland.* At the *Jutland-Iſlands.* Before the *Hever, Eider,* and *Elve,* on the Coaſt of *Holland.* At *Dover-Peer,* on *Beachy* Shore. At *Orfordneſs*; in the *Condado*; before *Enchuyſen, Horn,* and *Urk. Dunkirk.* Half-Tide at *Newport.* Half-Tide at *Portſmouth,* and the Iſle of *Wight.* In the *Sleeve* between *Uſhant* and *Silly.* At *Bolein* and *Graveling.* Before *Cherbrough,* and the *Race* of *Blanquet.* At the *Shoe, Lee,* and *Kentiſh Knock*; *Spits,* and along the *Swin. Port Deſire* in South *America.* From *Cape Cantin* to *Bojador* on the Coaſt of *Barbary.*

Setting of the Tides upon the ſame Point.

From the *Neſs* to *Boleign.*

North by Eaſt, and South by Weſt.

D.	H.	M.
0	12	45
1	01	33
2	02	21
3	03	09
4	03	57
5	04	45
6	05	33
7	06	21
8	07	09
9	07	57
10	08	45
11	09	33
12	10	21
13	11	09
14	11	57
15	12	45

12 *Hours,* 45 *Minutes.*

At *Garnſey.* At *Fluſhing.* Thwart of *Beachy* in the *Offing.* At *Winchelſey.* Within the *Maes.* Within *Terveer.* In the *Camber* of *Rie.* Weſt end of the *Nower.* At *Rocheſter,* and *Malden.* At *Fluſhing, North-Caen.*

Setting of the Tides upon the ſame Point.

From *Boleign* to the *Some.*

From *Staples* to *Boleign.*

North North-Eaſt, and South South-Weſt.

D.	H.	M.
0	01	30
1	02	18
2	03	06
3	03	54
4	04	42
5	05	30
6	06	18
7	07	06
8	07	54
9	08	42
10	09	30
11	10	18
12	11	06
13	11	54
14	12	42
15	01	30

01 *Hour*, 30 *Minutes.*

Before the *Maes* and *Goree.* Before *Terveer.* The *Weilings.* On the Coaſt of *Zealand.* Before the River of *Thames.* Before *Yarmouth.* In the *Downs.* Thwart of *Dongineſs.* From the Weſt-End of *Wight.* Without *Calice* and *Blackneſs.* In *Bluet.* At *Bell-Iſle*, under *Holy-Iſland*, *Tinmouth*, *Graveſend.* At *Corpus Chriſti* Point. Before the *Fen* in the Channel. At *Horn*, *Edam*, and before *Camfere.* At *Army*, *Ramkins*, and *Camfere.* At *Berwick.* On the Coaſt of *Finmark.* From the *Straits* Mouth to *Cape Cantin* on the Coaſt of *Barbary.*

Setting of the Tides upon the ſame Point.

From *Calice* to *Boleign.*

North-Eaſt by North, and South-Weſt by South.

D.	H.	M.
0	02	15
1	03	03
2	03	51
3	04	39
4	05	27
5	06	15
6	07	03
7	07	51
8	08	39
9	09	27
10	10	15
11	11	03
12	11	51
13	12	39
14	01	27
15	02	15

02 *Hours*, 15 *Minutes.*

Without *Bluet.* Before the *Maes.* Before the *Weilings.* St. *Andrews.* *Denby.* Without *Fountnay.*

Setting of the Tides upon the ſame Point.

Between *Calice* and *Dover.* From *Dunkirk* to *Graveling.* From *Staples* to *Feram.* From *Dartmouth* to *Exmouth.*

North-Eaſt, and South-Weſt.

D.	H.	M.
0	3	00
1	3	48
2	4	36
3	5	24
4	6	12
5	7	00
6	7	48
7	8	36
8	9	24
9	10	12
10	11	00
11	11	48
12	12	36
13	01	24
14	02	12
15	03	00

03 *Hours*, 00 *Minutes.*

At *London*, *Amſterdam*, *Dort*, *Rotterdam*, *Zerickzee.* Before *Newcaſtle.* In *Robin-hoods Bay.* Before the *Tees* and *Hartlepool.* Without the Banks of *Flanders.* Between *Calice* and *Dover.* Before *Conquet*, the *Pens*, *Groy*, *Armentiers*, *Vſe*, *Killiars*, *Porthus.* The River *Bourdeaux.* The South Coaſt of *Britain*, *Gaſcoin*, and *Poictou.* The Coaſt of *Biſcay*, *Gallicia*, *Portugal* and *Spain.* *North-Cape*, from the *Race* to the *Pole-head.* Before the River of *Nantz*, and before the Bay of *Tinmouth.* Quarter-Tide at *Flamborough-head*; on the Weſt Coaſt of *Ireland.* At *Buchaneſs* and *Orkneſs.* In *Shotland* and *Fair-Iſle.* At the *Iſland Teneriff.* And at *Cape Bon Eſperance.*

Setting of the Tides upon the ſame Point.

From *Cape de Hague* to *Alderney*, through the Race of *Alderney.*
From *Garnſey* to the *Caskets.*
From *Milford* to *Ramſey.*

North-Eaſt by Eaſt, and South-Weſt by Weſt.

D.	H.	M.
0	3	45
1	4	33
2	5	21
3	6	09
4	6	57
5	7	45
6	8	33
7	9	21
8	10	09
9	10	57
10	11	45
11	12	33
12	01	21
13	02	09
14	02	57
15	03	45

03 *Hours*, 45 *Minutes.*

Between *Dover* and *Calice.* At the *Maes.* At *Roven*, *Silly.* Before St. *Matthews Point.* At *Breſt.* In the *Sound.* Between *Vſhant* and the *Main.* Before the *Baſs.* At St. *Matthews.* Before *Rochel.* The River of *Bourdeaux* within the Haven. On the Coaſt of *Spain*, *Portugal*, *Gallicia.* The South ſide of *Britain*, *Gaſcoin*, and the Weſt Coaſt of *Ireland.* At *Huntclif-foot.* Half-Tide at *Flamborough-head.* Quarter-Tide between it and *Bridlington-Bay.*

Setting of the Tides upon the ſame Point.

From *Struyſaert* to *Deep.*
From the *Lizard* to the *Start.*
From *Cape Cleer* unto *Londey.*

Eaſt North-Eaſt, and Weſt South-Weſt.

D.	H.	M.
0	4	30
1	5	18
2	6	06
3	6	54
4	7	42
5	8	30
6	09	18
7	10	06
8	10	54
9	11	42
10	12	30
11	01	18
12	02	06
13	02	54
14	03	42
15	04	30

04 *Hours*, 30 *Minutes*.

Before *Humber*, *Flambrough*, *Scarbrough*, *Abberwark*. In *Falmouth*. In *Mouſe hole*, *Sept. Iſles*. Without the Haven, in the Broad Sound. Without the *Fourn*. All the South Coaſt of *Ireland*, as *Kingſale*, *Cork*, *Youghall*, *Waterford*, and *Cape Cleer*. In the *Breeſound* and *Vourd*. The Gleſts of *Texel*, *Bloy*, and St. *Matthews*. At the Bay within *Vſhant*. At *Calice* in the Creek. *Dungarvan*. *Baltimore*. Within *Mounts-Bay*. In the Sea of *Wales* and *Severn*.

Setting of the Tides upon the ſame Point.

From *Oſtend* to St. *Cateline*. From *Berchfleur* to *Struyſart*. The *Bree-Sound*, out and in. From *Cape Cleer* to the Iſle of *Salties*. Between *Londey* and the *Holms*, unto *Briſtol*. From *Silly* to the Lands-End of *England*. From the *Start* to *Portland*.

Eaſt by North, and Weſt by South.

D.	H.	M.
0	5	15
1	6	03
2	6	51
3	7	39
4	8	27
5	9	15
6	10	03
7	10	51
8	11	39
9	12	27
10	01	15
11	02	03
12	02	51
13	03	39
14	04	27
15	05	15

05 *Hours*, 15 *Minutes*.

In *Dartmouth* and *Plimouth*, *Foy* and *Torbay*, *Falmouth*, *Milford*, *Ramſey*. In *Wales*, thwart of *Londey*. Before *Lin*. In all the Havens on the South Coaſt of *Ireland*, and in the Bay of *Carnarvan*. At the Mouth of *Severn*. Between *Silly* and the *Lizard*. At the *Spurn*, *New-Caſtle*, and *Humber*. At *Moonleſs* and *Caldy*.

Setting of the Tides upon the ſame Point.

From the Iſle of *Baſs* to the *Fourn*. From the *Dorſes* to *Cape Cleer*. From *Silly* to the *Lizard*. From *Port laad* to *Wight*. From *Wight* to *Beachy*.

Eaſt and Weſt.

D.	H.	M.
0	6	00
1	6	48
2	7	36
3	8	24
4	9	12
5	10	00
6	10	48
7	11	36
8	12	24
9	1	12
10	2	00
11	2	48
12	3	36
13	4	24
14	5	12
15	6	00

06 *Hours*, 00 *Minutes.*

Before *Bremen*, *Teſſel*, and *Hamburgh.* At *Blackney*, *Wells*, *Hull*, *Concallo*, St. *Malo's*, St. *Powls* in the Haven. Without *Silly* in the Channel. Before *Bourdeaux.* Without *Uſhant.* At *Lin* Half-Tide. *Weymouth*, *Londey*, and the *Holms.* At *Briſtol*, *Waterford*, and *Abermorick.* At *Arch-angel.* At *Quebeck* in *Canada.* At the Mouth of the River *Amazons* in South *America* (if you add 15 min. more.)

Setting of the Tides upon the ſame Point.

From the *Caskets* to *Berchfleur.*

From the Lands-end of *England*, to the *Lizard.*

Eaſt by South, and Weſt by North.

D.	H.	M.
0	6	45
1	7	33
2	8	21
3	9	09
4	9	57
5	10	45
6	11	33
7	12	21
8	1	09
9	1	57
10	2	45
11	3	33
12	4	21
13	5	09
14	5	57
15	6	45

06 *Hours*, 45 *Minutes.*

Before St. *Nicholas*, and *Podeſemske.* In *Ruſſia.* At *Weymouth-Key*, *Briſtol-Key.* Between *Foy* and *Falmouth* in the Channel. *Foulneſs.* At *Garnſey* Half-Tide. Before St. *Nicholas* and *Podeſemske* in *Ruſſia.*

Setting of the Tides upon the ſame Point.

From the *Iſle de Baſs* to *Marwanen.*

Eaſt South-Eaſt, and Weſt North-Weſt.

D.	H.	M.
0	07	30
1	08	18
2	09	06
3	09	54
4	10	42
5	11	30
6	12	18
7	01	06
8	01	54
9	02	42
10	03	30
11	04	18
12	05	06
13	05	54
14	06	42
15	07	30

07 *Hours*, 30 *Minutes.*

Thwart of *Plimouth*, and of the *Start*, in the Channel. At the *Lizard* by the Land. Between *Mouſkole* and *Falmouth.* In the *Offing.* In the midſt of the Channel. At *Kilduyn.* In the Road of the *Texel.* At the *Neſs* by *Wieringhen.* At the Entrance of the *Emes*, or the River of *Embden.* Before the Coaſt of *Friezland* and the *Fly.* *Milford*-Haven. At *Cape Cleer.* *Florida* in *Carolina.*

Setting of the Tides upon the ſame Point.

From the Iſland *Bryack* to St. *Maloes.* From *Berchfleur* to *Seynhead.*

South-Eaſt by Eaſt, and North-Weſt by Weſt.

D.	H.	M.
0	08	15
1	09	03
2	09	51
3	10	39
4	11	27
5	12	15
6	01	03
7	01	51
8	02	39
9	03	27
10	04	15
11	05	03
12	05	51
13	06	39
14	07	27
15	08	15

08 *Hours*, 15 *Minutes.*

Thwart of the Iſland *Wight* in the Channel. Without the *Caskets* in the Channel. Betwixt the *Wight* and *Beachy* by the Shore. Without the *Fly.* To the Weſtwards of the *Foreland.* In St. *Magnes-Sound.* *Yarmouth.* At St. *Helens.* *Machnels-Caſtle.* *Dublin* and *Lambey.* *Cape Sierre lione* in *Guinea.*

Setting of the Tides upon the ſame Point.

Behind *Garnſey* in the *Fair-way.* Without the *Seven-Iſlands.*

South-Eaſt, and North-Weſt.

D.	H.	M.
0	09	00
1	09	48
2	10	36
3	11	24
4	12	12
5	01	00
6	01	48
7	02	36
8	03	24
9	04	12
10	05	00
11	05	48
12	06	36
13	07	24
14	08	12
15	09	00

09 *Hours*, 00 *Minutes.*

Between *Garnſey* and the *Caskets.* At the *Race* of *Portland.* At the Eaſt-end of *Wight.* Within the *Seyn.* Before *Cromer*, *Winterton*, and *Yarmouth*, *Friez*, and *Wieringen-Flat.* On the Coaſt of *Friezland.* Before the *Eaſtern* and *Weſtern-Emes.* Before the *Fly* and *Scholbalgh.* At *Egmont*, and *Harlem* of *Baſs.* Before the *Caskets* and *Garnſey.* At *Orkney*, *Dunbar*, and *Kilday.* At *Fair-Iſles*, *Seven-Clifts.* At *Home-head*, and thwart of *Plimouth* and *Dartmouth.* *Iſle of Man*, and *Cateneſs.* At the three Rivers in *Canada.*

Setting of the Tides upon the ſame Point.

In the Bay of *Benuyt.* Between *Morleux* and the *Treacle-Pots.*

South-Eaſt by South, and North-Weſt by Weſt.

D.	H.	M.
0	09	45
1	10	33
2	11	21
3	12	09
4	12	57
5	01	45
6	02	33
7	03	21
8	04	09
9	05	57
10	05	45
11	06	33
12	07	21
13	08	09
14	08	57
15	09	45

09 *Hours*, 45 *Minutes.*

Thwart of *Leyſtaff* without the Banks. The *Needles* at the *Iſle of Wight.* In the Channel thwart of *Wight.* The *Caskets* thwart of *Garnſey* in the Channel. At *Dunnoſe*, *Tergou*, *Orfordneſs*, and *Albrough.* At *Leyſtaff*, and at *Chamberneſs.* At *Cape Blanco* in *Africa.*

Setting of the Tides upon the ſame Point.

Before *Concala*, and the Iſland of St. *Michael.*

South South-Eaſt, and North North-Weſt.

D.	H.	M.
0	10	30
1	11	18
2	12	06
3	12	54
4	01	42
5	02	30
6	03	18
7	04	06
8	04	54
9	05	42
10	06	30
11	07	18
12	08	06
13	08	54
14	09	42
15	10	30

10 *Hours*, 30 *Minutes*.

At St. *Helens*, and the *Cows*. At *Orfordneſs*, and *Harwich* without the Banks. In *Yarmouth*, and *Leyſtaff*-Road. Before the River of *Thames*. Between the Iſle of *Wight* and the *Main*. At *Bulleyn-deep*, and *Seyn-head*. In the *Foſſe* of *Caen*. At *Struyſaert*, and all the Coaſt of *Normandy* and *Picardy*. *Calice*-Road. In the *Frith*. At *Leyſtaff*, Quarter-Tide. *Harwich*, *Dover*, and the *South-Foreland*. Between *Orford* and *Orwel-Waves*. In *Chamberneſs*-Road. In the *Downs*. At *Senegal*.

Setting of the Tides upon the ſame Point.

From *Berchfleur* to *Albonga*.

From *Cape Dorſey* to the Iſland *Darden*.

South by Eaſt, and North by Weſt.

D.	H.	M.
0	11	15
1	12	03
2	12	51
3	01	39
4	02	27
5	03	15
6	04	03
7	04	51
8	05	39
9	06	27
10	07	15
11	08	03
12	08	51
13	09	39
14	10	27
15	11	15

11 *Hours*, 15 *Minutes*.

At *Cows* and *Orfordneſs* within the Sands, and *Hampton*, *Portſmouth*, and *Dunnoſe*. Before the Haven of *Caen*. *Fair-Iſle*-Roads. *Harwich* within. Between the *Naze* and *Warhead* of *Lower*. In the *Chamber* and *Gore*-end. Between *Cripple-Sand* and the *Creyl*. In the *Frith*, and before *Margate*.

Setting of the Tides upon the ſame Point.

From S. *Matthew's-Point* to the *Bake-Ovens*.

From *Fontney* to St. *Matthew's-Point*.

A Table of the true time of High-Water at London-bridg, *according to the Moon's Southing. By Mr.* Henry Phillips *deceaſed.*

Moon South.		Tide *London.*		Moon South.		Tide *London.*		Moon South.		Tide *London.*	
H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
XII	00	03	00	IV	00	05	52	VIII	00	09	53
	10	03	09		10	05	59		10	10	06
	20	03	18		20	06	06		20	10	20
	30	03	27		30	06	13		30	10	33
	40	03	36		40	06	20		40	10	47
	50	03	45		50	06	28		50	11	01
I	00	03	54	V	00	06	36	IX	00	11	15
	10	04	02		10	06	44		10	11	29
	20	04	09		20	06	53		20	11	43
	30	04	16		30	07	02		30	11	57
	40	04	23		40	07	11		40	12	10
	50	04	30		50	07	20		50	12	24
II	00	04	37	VI	00	07	30	X.	00	12	37
	10	04	44		10	07	41		10	12	50
	20	04	50		20	07	52		20	01	03
	30	04	57		30	08	04		30	01	16
	40	05	03		40	08	14		40	01	29
	50	05	09		50	08	25		50	01	42
III	00	05	15	VII	00	08	36	XI	00	01	54
	10	05	21		10	08	48		10	02	03
	20	05	27		20	09	00		20	02	16
	30	05	33		30	09	13		30	02	27
	40	05	40		40	09	26		40	02	38
	50	05	46		50	09	39		50	02	49

Days.	*January*		*Febr.*		*March.*		*April.*		*May.*		*June.*	
	☉ Right Aſcen.		☉ Right Aſcen.		☉ Right Aſcen.		☉ Right Aſcen.		☉ Right Aſcen.		☉ Right Aſcen.	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	19	35	21	42	23	28	01	21	03	14	05	19
2	19	39	21	46	23	32	01	25	03	18	05	23
3	19	43	21	50	23	36	01	29	03	22	05	27
4	19	47	21	54	23	39	01	33	03	26	05	31
5	19	51	21	58	23	43	01	36	03	30	05	36
6	19	56	22	02	23	46	01	40	03	34	05	40
7	20	00	22	06	23	50	01	44	03	38	05	44
8	20	04	22	10	23	53	01	47	03	42	05	48
9	20	09	22	14	23	57	01	51	03	46	05	52
10	20	13	22	17	00	01	01	54	03	50	05	56
11	20	17	22	21	00	05	01	58	03	54	06	00
12	20	22	22	25	00	08	02	02	03	58	06	04
13	20	26	22	29	00	12	02	06	04	02	06	08
14	20	30	22	33	00	15	02	10	04	06	06	12
15	20	34	22	36	00	19	02	13	04	10	06	17
16	20	38	22	40	00	23	02	17	04	14	06	21
17	20	42	22	44	00	26	02	21	04	18	06	25
18	20	46	22	48	00	30	02	25	04	22	06	29
19	20	50	22	52	00	33	02	29	04	26	06	33
20	20	54	22	55	00	37	02	32	04	30	06	38
21	20	58	22	59	00	41	02	36	04	34	06	42
22	21	03	23	03	00	44	02	40	04	38	06	46
23	21	07	23	06	00	48	02	44	04	42	06	50
24	21	11	23	10	00	52	02	48	04	46	06	54
25	21	15	23	13	00	55	02	51	04	50	06	58
26	21	19	23	17	00	59	02	55	04	54	07	02
27	21	23	23	21	01	03	02	59	04	58	07	06
28	21	27	23	25	01	06	03	03	05	02	07	10
29	21	31			01	10	03	07	05	06	07	14
30	21	35			01	14	03	10	05	11	07	19
31	21	38			01	17			05	15		

A Table of the Sun's Right Aſcenſion.

Days.	*July.*		*Auguſt.*		*Septem.*		*Octob.*		*Novem.*		*Decem.*	
	⊙ Right Aſcen.		⊙ Right. Aſcen.		⊙ Right Aſcen.		⊙ Right Aſcen.		⊙ Right Aſcen.		⊙ Right Aſcen.	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	07	23	09	25	11	19	13	08	15	07	17	15
2	07	27	09	29	11	23	13	12	15	11	17	20
3	07	31	09	33	11	26	13	15	15	15	17	25
4	07	35	09	37	11	30	13	19	15	19	17	29
5	07	39	09	40	11	33	13	22	15	23	17	34
6	07	43	09	44	11	37	13	26	15	27	17	38
7	07	47	09	48	11	41	13	30	15	31	17	42
8	07	51	09	51	11	44	13	34	15	36	17	47
9	07	55	09	55	11	48	13	38	15	40	17	51
10	07	59	09	58	11	51	13	41	15	45	17	56
11	08	03	10	02	11	55	13	45	15	49	18	00
12	08	07	10	06	11	59	13	49	15	53	18	05
13	08	11	10	10	12	02	13	53	15	58	18	09
14	08	15	10	14	12	06	13	57	16	02	18	14
15	08	10	10	17	12	09	14	00	16	07	18	19
16	08	23	10	21	12	13	14	04	16	11	18	24
17	08	27	10	25	12	17	14	08	16	15	18	28
18	08	31	10	28	12	20	14	12	16	19	18	33
19	08	35	10	32	12	24	14	16	16	23	18	37
20	08	39	10	35	12	27	14	20	16	28	18	41
21	08	43	10	39	12	31	14	24	16	32	18	45
22	08	47	10	43	12	35	14	28	16	36	18	49
23	08	51	10	46	12	38	14	32	16	40	18	54
24	08	55	10	50	12	42	14	36	16	44	18	58
25	08	58	10	53	12	45	14	39	16	49	19	03
26	09	02	10	57	12	49	14	43	16	53	19	07
27	09	06	11	01	12	53	14	47	16	57	19	11
28	09	10	11	04	12	57	14	51	17	02	19	16
29	09	14	11	08	13	01	14	55	17	06	19	20
30	09	17	11	11	13	04	14	59	17	11	19	25
31	09	21	11	15			15	03			19	30

A

A Table of Right Aſcenſion and Declination of ſome of the moſt notable Fixed Stars.

Stars Names.	Magnit.	Right Aſcenſ. H.	Right Aſcenſ. M.	Declination. D.	Declination. M.	N. or S.
Pole Star	02	00	32	87	33	N
The upper of the two foremoſt of the Square in the Little Bear	02	14	51	75	36	N
The upper of the two foremoſt of the Square in the Great Bear	02	10	43	63	32	N
The lower of the two foremoſt of the Square in the Great Bear	02	10	41	58	08	N
The lower of the two latter of the Square of the Great Bear	02	11	36	55	33	N
The upper of the two latter in the Square of the Great Bear	02	11	59	58	51	N
Laſt but two in the Great Bear's Tail	02	12	40	57	47	N
Laſt but one in the ſame	02	13	10	56	41	N
Laſt in the ſame	02	13	34	51	00	N
The Dragon's Tail	02	13	59	65	56	N
Arcturus	01	14	01	20	58	N
Brighteſt in the Crown	02	15	21	27	51	N
Brighteſt in the Harp	01	18	26	38	30	N
Swan's Tail	02	20	30	44	05	N
Perſeus Right Side	02	02	57	48	36	N
Goat or *Capella*	01	04	52	45	37	N
Auriga's Right Shoulder	02	05	44	44	56	N
Brighteſt in the Serpent's Neck	02	15	28	07	30	N
Brighteſt between the Eagle's Shoulders	02	19	35	08	03	N
Firſt in Pegaſus Wing, or Marchab	02	22	48	13	28	N
Beginning of Pegaſus Leg	02	22	48	26	18	N
End of Pegaſus Wing	02	23	57	13	22	N
Andromeda's Head	02	23	52	27	18	N
Southermoſt in Andromeda's Girdle	02	00	51	33	55	N
Andromeda's Southermoſt Foot	02	01	44	40	44	N

A Table of Right Aſcenſion and Declination of ſome of the moſt notable Fixed Stars.

Stars Names.	Magnit.	Right Aſcenſ. H.	Right Aſcenſ. M.	Declination. D.	Declination. M.	N. or S.
The Bull's Eye, or Aldebrand	01	04	17	15	48	N
End of the Bull's Horn	02	05	06	28	21	N
Caſtor	02	07	14	32	33	N
Pollux	02	07	25	28	46	N
Bright Foot of Gemini	02	06	19	16	38	N
Brighteſt in the Lion's Neck	02	10	02	21	29	N
Lion's Heart	01	09	51	13	33	N
Lion's Tail	01	11	32	16	25	N
Virgin's Spike	01	13	08	09	31	S
Southermoſt Scale of Libra	02	14	33	14	37	S
Northermoſt Scale of Libra	02	14	59	08	07	S
Scorpion's Forehead	02	15	46	18	51	S
Scorpion's Heart	01	16	10	25	37	S
Fomahaut	01	22	39	31	17	S
Whale's Jaw	02	02	45	02	48	N
Orion's Right Shoulder	02	05	38	07	18	N
Orion's Left Shoulder	02	05	08	06	01	N
Firſt in Orion's Belt	02	05	15	00	35	S
Middle of Orion's Belt	02	05	20	01	26	S
Laſt in Orion's Belt	02	05	24	02	09	S
Orion's Left Foot, or Regel	01	04	59	08	37	S
Mouth of the Great Dog, or Syrius	01	06	31	16	14	S
Right Forefoot of the Great Dog	02	06	09	17	49	S
Little Dog's Thigh	02	07	22	06	03	N
Hydra's Heart.	01	09	12	07	15	S

To

To know the Hour when any Star cometh upon the Meridian.

The Rule.

FIrſt ſeek the Right-Aſcenſion of the Star, and alſo the Right-Aſcenſion of the Sun in the Tables aforegoing: From the Right-Aſcen. of the Star ſubtract the Right-Aſcen. of the Sun. But when the Right-Aſcenſion of the Star is leſs than the Right-Aſcenſion of the Sun, then add 24 Hours thereto, and the Remainder will ſhew you the Hour Afternoon when the Star cometh upon the Meridian; and if it does exceed 12 Hours, then ſubtract 12 Hours therefrom, and the Remainder ſhall ſhew the Hour and Minute of the Star's coming upon the Meridian after Midnight.

Example 1.

Upon the 10*th* of *April*, I would know when the *Lion's Heart* cometh upon the Meridian: Therefore if you look in the Tables of Right-Aſcenſion and Declination for that Star, you will find it to be 9 Hours 51′. Then look in the Tables of the Right-Aſcenſion of the Sun, and right againſt the 10*th* of *April* you will find the Right-Aſcenſion of the Sun to be 1 Hour 54′, which ſubtracted from the Right-Aſcenſion of the Star, there remain 7 Hours 57′, which is the Time that the Star cometh to the Meridian Afternoon.

Example 2.

Upon the 5*th* of *November*, I deſire to know when the *Bull's Eye* cometh upon the Meridian. The Right-Aſcenſion thereof by the Tables you will find to be 4 hours 17′, the Right-Aſcenſion of the Sun that Day is 15 Hours 23′. Therefore becauſe the Right-Aſcenſion of the Star is leſs than the Right-Aſcenſion of the Sun, I add 24 hours to the Right-Aſcenſion of the Star, which maketh 28 hours 17 min. From which ſubtract the Right-Aſcenſion of the Sun, and the Remainder is 12 hours 54 min. from which I ſubtract the 12 hours, and the Remainder is 54 min. So that the ſaid Star cometh upon the Meridian 54 min. after Midnight.

And here note, That the Table of Right-Aſcenſion of the Sun is calculated for Noon every Day, and that it doth encreaſe by about 4 min. each Day; ſo that it may be proportioned, by allowing for every 6 hours after Noon one Minute.

A Table of the Latitudes and Longitudes of the principal Ports, Harbours, Capes and Iſlands, in moſt of the known Parts of the World: Beginning from the Meridian of *Pico Teneriffa*. Collected from the beſt Charts, Deſcriptions, and Obſervations of ſeveral able and experienced Navigators of our own, and other Nations.

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
The Sea-Coaſt of *Greenland.*	*Hacluits Headland*	79	50	N	26	55
	Fair Foreland	79	15	N	24	50
	Black Point	78	32	N	25	10
	Point Look-out	76	25	N	32	00
	Cape Blanco	78	25	N	38	00
	Point Negro	77	10	N	42	00
	Hopeleſs Iſles.	77	00	N	42	30
Iſlands in the *North-Sea.*	*Hope Iſland*	76	13	N	41	50
	Cherry Iſland	74	34	N	34	10
	South-Point of Trinity Iſland	71	00	N	07	55
	Young's Foreland in *Trinity Iſland.*	71	23	N	10	20
Sea-Coaſt of *Nova-Zembla.*	*Orange Iſland*	78	25	N	91	35
	Ice Point	77	45	N	90	50
	Admiralties Iſland	75	50	N	73	55
	Langeneſs	74	55	N	68	50
	Croſs Point	72	25	N	68	05
	Fretum Burrough	70	40	N	75	00
	The River Obu *in the Tartarian Sea*	69	12	N	80	49
	Mauritias Iſle	71	24	N	72	10
Sea-Coaſt in the *White-Sea.*	*Archangel*	63	22	N	55	28
	Swelgenoſe	69	10	N	61	38
	Cape Candenoſe	69	35	N	58	00
	Orlogenoſe.	66	55	N	54	56

Fox

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Sea-Coaſt of *Lapland* and *Norway*.	*Fox Noſe*	64	12	N	37	07
	Cape Grace	65	17	N	39	30
	Cape Gallant	67	11	N	39	32
	Cape Race	65	49	N	40	04
	Iſland Kilduyn	68	54	N	38	05
	North Cape	71	22	N	32	35
	Roſs Iſles	67	01	N	25	06
	Catſneſs	61	54	N	18	42
	Bomel	59	32	N	19	38
	Naze of *Norway.*	58	00	N	21	02
The Sea-Coaſt in the *Sound*.	*The Nyding*	57	00	N	25	40
	Cape Cole	56	46	N	26	12
	Scarlet Iſland	56	02	N	26	38
	Falſterborn	56	53	N	26	25
	Abbo	61	08	N	34	30
	Wyburrough	61	16	N	40	18
	Dagaret	59	44	N	34	31
	Dormamel	56	55	N	34	31
	Gotland	58	20	N	31	05
	Horroſound	58	48	N	32	58
	Gothſound	59	15	N	32	29
	Earth Holme	56	10	N	28	14
	Burnt-Holme	56	00	N	28	16
	Elſenore.	56	40	N	25	57
The Sea-Coaſt of *Flanders*, from the *Schaw* to *Callis*.	*The Schaw*	57	52	N	24	27
	Bovenberg	56	20	N	23	56
	Holy Land	54	30	N	22	14
	The Texel	53	20	N	20	56
	The Brill	52	08	N	19	44
	Calis.	51	13	N	17	52

	Places Names.	Latitude.			Longitude.	
		D.	M.		D.	M
Sea-Coaſt of *Iſeland.*	*Langeneſs*	67	20	N	003	45
	Grinſe	67	00	N	352	05
	Maze	68	25	N	351	10
	Andifer	66	30	N	345	00
	Snowhill	65	40	N	344	40
	Alcra Poine	64	08	N	344	20
	Weſtmonia Iſles	63	35	N	349	00
	Merchants Foreland	63	36	N	358	40
	Whale's Back.	65	18	N	003	00
Iſlands near the Coaſt of *Scotland.*	St. *Kilda*	58	02	N	05	56
	Sky Iſland	57	40	N	10	08
	Lewis Iſland	58	30	N	08	00
	Fair Iſlands	61	43	N	09	00
	Shotland	60	22	N	14	30
	Fair Iſle	59	30	N	14	20
	Iſles of *Orkney.*	58	50	N	13	25
The Sea-Coaſt of *Scotland, England*, and *Ireland.*	*Catneſs*	58	37	N	13	24
	Buchanneſs	58	00	N	14	32
	St. *Abb's Head*	56	25	N	14	12
	Tinmouth	55	08	N	15	00
	Flambrough-Head	54	08	N	16	26
	The Sporne	53	45	N	16	58
	Wintertonneſs	52	52	N	18	00
	Orfordneſs	52	20	N	18	02
	The North-Foreland	51	32	N	17	40
	The South-Foreland	51	22	N	17	42
	Dongeneſs	51	09	N	17	14
	Iſle of *Wight*	50	24	N	14	47
	Portland	50	20	N	13	46
	The Start	50	27	N	13	09
	The Lizard	50	00	N	12	37
	Iſlands of *Silly*	50	07	N	09	4
	Londy Iſle	51	22	N	11	5
	St. *David's Head*	51	44	N	11	18

Brad-

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Sea-Coaſt of Scotland, England, and Ireland.	*Bradſey Iſle*	52	46	N	01	93
	Holy Head	54	44	N	11	44
	Iſle of *Man*	54	25	N	11	45
	Coſwel-Point	54	36	N	11	18
	Fair Foreland	55	35	N	10	16
	Aron Iſle	53	21	N	08	30
	Black Rock	53	52	N	06	00
	Sline Head	53	16	N	06	00
	Blaſques	52	15	N	05	20
	Cape Clear	51	15	N	06	28
	Old Head	51	40	N	07	32
	Hearn-Point.	52	05	N	10	04
Sea-Coaſt of France, Spain, and Portugal.	*Sein Head*	50	04	N	16	50
	Cape Hage	50	04	N	15	05
	Caskets	50	07	N	14	30
	Garnſey	49	43	N	14	20
	Jerſey	49	30	N	14	46
	Uſhant	48	40	N	11	16
	Oleroon	45	58	N	11	00
	Cape de Machicaca	44	22	N	14	20
	Cape Pinas	44	04	N	11	10
	Cape Ortegal	44	08	N	09	16
	Cape Finiſterre	43	10	N	06	58
	The Rock of *Lisbon*	38	52	N	06	43
	Cape St. *Vincent*	37	00	N	07	20
	Cape St. *Maria*	37	05	N	08	42
	The Straits of *Gibralter.*	36	00	N	10	40

Cape

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M
The Sea-Coaſts on the *Main-Continent* in the *Straits.*	*Cape de Gata*	36	47	N	16	08
	Cape St. *Martin*	38	46	N	18	57
	Cape Daga Frito	41	41	N	21	49
	Cape Larei	42	58	N	24	28
	Cape Melle	43	51	N	26	21
	Terracina	41	26	N	31	26
	Cape Spartaventura	37	46	N	36	06
	Cape Collom	38	50	N	37	3
	Cape St. *Maria*	39	52	N	38	16
	Angelo	41	31	N	36	28
	Ancana	43	25	N	32	40
	Cape Ceſta	43	27	N	34	55
	Raguſa	42	29	N	37	36
	Cape Linga	40	19	N	38	50
	Cape Matopan	36	28	N	42	00
	Cape St. *Angelo*	37	15	N	42	56
	Cape Doro	39	14	N	45	12
	Cape Barbarnou	37	58	N	46	19
	Cape Saradoni	35	35	N	48	46
	Cape Pallopollo	34	54	N	55	34
	Cape de Becur	32	40	N	50	48
	Cape Roatini	32	18	N	43	32
	Cape Rozato	32	58	N	40	28
	Cape Bona	37	05	N	30	12
	Collo	37	09	N	24	52
	Tunis	36	40	N	19	46
	Cape Falcon	36	08	N	17	28
	Cape Tres Forcas	35	40	N	15	24
	Tangier.	35	36	N	11	35
Iſlands within the *Straits.*	*Alboran*	37	52	N	15	18
	Formentara	38	44	N	19	38
	Ivica	39	05	N	19	50
	Majorca	39	38	N	21	2
	Minorca	39	55	N	22	30

Gallatta

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Iſlands within the *Straits.*	*Gallatta*	37	57	N	27	50
	Cape Pulo in *Sardinia*	38	56	N	27	36
	Cape Corſo in *Corſica*	42	51	N	27	32
	Lilbo	42	51	N	29	00
	Palmorella	40	50	N	31	12
	Uſtica	38	46	N	32	48
	Maritimo	37	52	N	30	54
	Pantalaria	36	53	N	31	00
	Limpadoſa	35	58	N	31	52
	Limoſa	36	25	N	32	05
	Malta	36	00	N	33	12
	Cape Paſſaro in *Sicilia*	37	10	N	34	52
	Meſſina	38	07	N	35	08
	Liſſa	43	00	N	35	22
	Trinity	41	50	N	35	14
	Palagoſa	42	17	N	35	50
	Auguſta	42	36	N	36	12
	Mallida	42	37	N	37	04
	Corfu	39	25	N	39	18
	Cephalonia	38	28	N	40	29
	Zant	37	37	N	40	40
	Weſt End of *Candia*	35	15	N	43	00
	Eaſt-End of *Candia*	35	04	N	46	28
	Rhodes	35	40	N	48	00
	Weſt End of *Cyprus*	34	22	N	51	34
	Eaſt End of *Cyprus*	34	48	N	54	35
Sea-Coaſt of *Barbary* and *Guinny.*	*Cape Spartel*	35	38	N	11	35
	Cape Cantin	32	27	N	07	35
	Cape Bojador	26	55	N	02	24
	Cape Blanco	20	32	N	358	56
	Cape Verde	14	36	N	358	50
	Sirre Leone	08	00	N	03	32
	The South ſide of St. *Anne*	06	40	N	01	11

	Places Names.	Latitude. D.	Latitude. M.		Longit. D.	Longit. M
Sea-Coaſt of *Barbary* and *Guinny*.	*Cape de Palmas*	04	10	N	10	00
	Cape Tres Punctas	04	06	N	16	00
	Cape Formoſa	04	10	N	24	15
	The North Point of *Fernando*	03	25	N	27	25
	Iſland Principas	01	50	N	28	20
	Iſland Chocos	00	40	N	03	32
	Iſland St. *Thoma*	00	10	N	27	30
	Cape Lupus	01	00	S	27	40
	Cape Negro	16	00	S	30	50
	Cape Sacos	29	40	S	36	20
	Cape Bona Eſperanza.	34	24	S	38	10
Weſtern Iſlands.	*The Weſt-ſide* of *Corva*	40	00	N	345	30
	The Weſt-ſide of *Flores*	39	40	N	345	30
	The Road before Fyal	38	50	N	347	47
	The Weſt end of *Pico*	38	40	N	348	18
	The Weſt-end of St. *George*	39	00	N	348	30
	The Weſt-end of *Tercera* 39:00	39	00	N	349	10
	The Eaſt-end of St. *Michaels*	38	00	N	351	40
	The Eaſt-end of St. *Maries.*	37	90	N	351	30
The *Canary* Iſlands.	*The North part* of *Ferro*	27	40	N	358	25
	The Eaſt ſide of *Palme*	28	36	N	358	43
	Gomera	28	10	N	359	15
	Pico Teneriffa	28	20	N	00	00
	The Eaſt-end of *Madera*	32	32	N	00	10
	The Eaſt-end of *Port Sancto*	33	00	N	01	00
	The North-Eaſt Point of *Canaria*	28	10	N	01	00
	The N. E. Point of *Forteventura*	28	20	N	02	50
	The Eaſt-part of *Lancerotta*	28	30	N	03	10

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Cape de Verde Iſlands.	The *Weſt-ſide* of *Antonio*	17	00	N	350	00
	The Eaſt Point of St. *Vincent*	17	40	N	350	08
	The Eaſt-ſide of *St. Lucia*	16	50	N	351	40
	Iſle Brava	14	40	N	351	08
	Iſle Fogo	14	00	N	351	30
	The Eaſt-ſide of St. *Jago*	15	00	N	352	30
	The Side of *de Mopo Iſle*	15	00	N	353	04
	Eaſt-ſide of the *Iſle* of *Sal*	16	00	N	353	04
	Eaſt-ſide of *Bona Viſta.*	16	00	N	353	04
	St. *Matthews*	01	40	S	11	32
	Iſland Anabona	01	22	S	26	20
	Aſcenſion	08	00	S	04	30
	St. *Helena*	16	00	S	13	50
	St. *Helena Nova*	16	03	S	24	48
	Iſland Degialica	37	56	S	12	00
	Iſland Deſiſtian.	36	57	S	12	42
Sea-Coaſt of the Main-Continent in *Eaſt-India.*	*Cape Anquilhas*	35	00	S	39	30
	Cape Corintes	23	30	S	56	00
	Cape de Guada	15	17	S	59	56
	Cape de Guardaſin	11	40	N	74	15
	Cape de Raſalgate	22	07	N	84	10
	Surat	21	04	N	96	20
	Goa	15	40	N	97	00
	Cape Comerin	07	52	N	99	12
	The S. W. Point of *Ceylon*	06	00	N	101	56
	River Bengale	22	09	N	110	20
	River de Care	10	45	N	119	10
	Johr	01	25	N	125	06
	Siam	14	52	N	122	45

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Sea-Coaſt on the Main-Continent in *Eaſt-India.*	*Cambodia*	12	42	N	120	00
	Viſchers Point	20	18	N	131	00
	The *Point* of *Cavallos*	25	16	N	140	58
	Cape Somber	28	07	N	142	50
	Ninghai	36	40	N	142	26
	Corea.	36	05	N	146	00
Iſlands in the *Eaſt-India.*	*Romeyros*	28	19	S	89	40
	John de Lisbon	25	24	S	75	52
	Diego Roize	20	05	S	85	05
	St. *Branda*	17	13	S	87	50
	Dolgatias	15	20	S	62	15
	Moroſtas	20	10	S	78	36
	Domaſcaicaes	20	50	S	74	00
	St. *Apollonia*	20	50	S	74	00
	South-end of St. *Lawrence*	25	37	S	68	00
	North-end of St. *Lawrence*	11	03	S	73	00
	Baſtos de India	22	10	S	60	40
	John de Nova	17	20	S	63	15
	Mayotta	12	40	S	66	30
	Comore	11	20	S	65	10
	De Natal	08	20	S	68	05
	Coſmolede	09	40	S	72	08
	John de Nova	09	00	S	79	46
	De Almiranta	03	57	S	76	00
	Domeſcaicubas	03	21	S	80	26
	St. *Hermanas*	03	02	S	84	00
	Diego Gratioſa	08	03	S	92	20
	De Gamo	02	40	S	99	05
	Adu	05	39	S	99	00
	Apoluria	09	20	S	100	40
	Iſſand Pracel	10	23	N	93	14

Cubile

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Iſlands in the *Eaſt-India.*	*Cubile*	8	53	N	93	30
	Molique	9	05	N	94	25
	Andaro	11	30	N	95	38
	The North-Weſt Point of *Sumatra*	5	30	N	116	00
	South-Eaſt end of *Sumatra*	5	52	S	125	40
	Bantam	6	15	S	126	30
	Batavia	6	10	S	127	05
	Combava	8	36	S	138	00
	Flores	8	50	S	140	48
	Timor	9	52	S	145	53
	Ceram	3	26	S	148	20
	Amboina	3	52	S	147	25
	South-end of *Celebes*	5	45	S	139	30
	North-Point of *Celebes*	2	16	N	144	06
	The Middle of *Gilolo*	0	00	X	147	20
	Bachian	0	03	N	146	10
	Machian	0	14	N	146	06
	Motir	0	25	N	146	08
	Pottobackers	0	32	N	146	10
	Tidore	0	41	N	146	16
	Miferra	0	43	N	146	14
	Ternate	0	47	N	146	12
	St. *Johannes*	4	10	N	138	50
	South Point of *Burneo*	4	16	S	135	04
	North Point of *Burneo*	7	40	N	134	35
	Weſt-end of *Mindano*	6	50	N	141	25
	Anamba	2	38	N	126	42
	Natura	3	30	N	127	45
	St. *Juan*	8	16	N	146	20
	Tandia	12	00	N	145	05
	Masbat	11	50	N	143	35
	Sebu	9	55	N	143	10
	Pandi	11	05	N	142	00
	Mindora	12	50	N	140	28
	Paragoa	9	40	N	136	30
	South-end of *Lucon*	12	42	N	143	45

North-

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Iſlands in the *Eaſt-India.*	*North-end* of *Lucon*	18	42	N	141	56
	The Middle of *Aynam*	19	00	N	131	00
	South-end of *Formoſa*	21	20	N	142	05
	North-end of *Formoſa*	28	10	N	143	16
	Firando Iſle	33	00	N	157	15
	Weſt-end of Japan	34	00	N	150	05
	North-end of Cikoko	34	05	N	150	10
	Tonſa	33	25	N	153	00
	North-Point of *Japan*	40	05	N	163	20
	Cape Eroen in *Jeſo*	42	50	N	183	20
	Cape Patience in *Jeſo.*	49	00	N	186	00
The Coaſt of *America* in the *South-Sea.*	*The Straits* of *Anian*	57	10	N	251	56
	Cape Blanco	42	00	N	245	10
	Sir *Francis Drake's Bay*	38	16	N	246	30
	Iſland Pararos	30	08	N	253	50
	Cape St. *Lucas*	23	10	N	266	10
	Cape Corintes	20	28	N	270	56
	Aquatulco	16	45	N	283	50
	Gulf of *Salina*	10	00	N	288	20
	Cape St. *Maria*	07	08	N	293	06
	Cape Corintas	05	26	N	295	20
	Cape de Franciſco	01	25	N	292	20
	Cape de Paſſao	00	00	X	291	35
	Payta	04	30	S	293	00
	Truxilla	08	05	S	295	00
	Villa la Naſca	15	10	S	297	50
	Arica	18	35	S	202	00
	Iſland Ferando	33	47	S	292	20
	Baldivia	40	00	S	297	35
	P. St. *Cyprian*	43	16	S	296	38
	Weſt-Entrance of *Magellan*	53	00	S	296	42
	Cape Horn.	57	54	S	303	00

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Iſlands in the *Great South-Sea.*	*Hender Iſland*	14	00	S	237	30
	Water Iſlands	14	50	S	229	00
	Iſland Tiburones	12	00	S	218	05
	St. *Pedro*	22	10	S	229	10
	Prince William's *Iſlands*	18	14	S	204	50
	Iſlands of *Good Hope*	17	12	S	195	40
	States Land	38	00	S	192	00
	Green Iſlands	04	00	S	172	00
	Salteadores Iſle	06	40	N	172	05
	Miracomo	06	24	N	175	40
	Iſlands de Ladrones	10	00	N	170	00
	Nadadores	04	22	N	186	55
	Barbadoes Iſles	07	00	N	195	05
	St, *Peter's Iſle*	11	14	N	205	00
	Harmanes Iſle	15	10	N	181	05
Sea-Coaſt on the *Main-Continent* of *America.*	*Lemairs Strait*	55	00	S	310	16
	Cape Pennas	53	45	S	307	20
	Eaſt-Entrance of *Magelan*	52	20	S	305	00
	Cape Blanco	47	30	S	309	45
	Cape St. *Antonio*	36	38	S	325	00
	Cape St. *Maria*	35	00	S	325	40
	Cape Frio	22	52	S	338	38
	Baja de toda Santos	13	00	S	341	50
	Cape St. *Auguſtin*	08	40	S	345	40
	Black Point	03	10	S	343	00
	River Caſſepore	04	00	N	328	05
	Suranam	05	05	N	323	40
	Cape Three Points	11	18	N	314	20
	Cape de Coquibocao	12	42	N	305	24
	Carthagene	10	25	N	298	25
	Cape de Gratias	15	32	N	291	55
	Cape de Catoche	21	23	N	287	00
	Cape Rexo	22	40	N	275	26
	Cape Blanco.	26	55	N	274	56

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Sea-Coaſt on the *Main-Continent* of *America.*	*Cape Eſcondido*	29	52	N	285	40
	La Florida	25	51	N	272	16
	Cape Fair	34	02	N	298	25
	Cape Henry	37	00	N	300	40
	Cape Charles	37	48	N	300	54
	Cape May	39	55	N	302	00
	The Eaſt-end of *Long-Iſland*	40	45	N	303	17
	Cape Cod	42	20	N	308	40
	Cape Ann	42	45	N	308	16
	Cape Furcu	44	00	N	314	10
	Eaſt end of the *Iſle of Sables*	43	40	N	323	00
	Cape Britain	45	30	N	323	15
	Cape Raze	46	36	N	328	30
	Conception Bay	48	22	N	327	50
	Bay of Bulls	47	27	N	328	05
	Cape Bona Viſta	49	19	N	328	36
	Pengwins Iſle	50	02	N	328	40
	Cape Gate	52	00	N	325	32
	Bell Iſle.	52	25	N	325	30
Iſlands in the *Weſt-India.*	*Bermudas*	32	18	N	310	50
	Behama	27	57	N	295	20
	North-Eaſt Point of *Lucaonique*	27	52	N	298	20
	Signateo	26	18	N	300	00
	Guatro	25	47	N	301	00
	Guamina	25	15	N	301	40
	Tiango	24	33	N	302	20
	Majagana	23	05	N	303	00
	Caicos	22	05	N	304	05
	Ihagua	21	19	N	301	40
	Yamata	22	32	N	301	20
	Samana	24	20	N	295	45
	Yamia	24	30	N	301	05

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
Iſlands in the *Weſt-Indies.*	*Anguilla*	18	48	N	313	35
	St. *Chriſtophers*	17	30	N	313	30
	South-end of Barbada	17	36	N	316	00
	Antego	16	32	N	315	10
	Guadalupa	16	00	N	314	40
	Marigallata	15	41	N	315	25
	Dominica	15	00	N	314	50
	Martineco	14	30	N	316	36
	St. *Lucia*	13	13	N	315	20
	Barbadoes	13	12	N	319	40
	St. *Vincent*	12	50	N	313	45
	Granada	12	10	N	314	40
	Tobago	11	12	N	317	00
	Point de Gallaia	10	45	N	316	55
	Mevis	17	00	N	314	00
	Monſerrat	16	20	N	314	20
	Margaretta	11	28	N	312	25
	Tortogas	11	30	N	313	30
	Doikilla	12	19	N	310	30
	Bonayre	12	32	N	308	35
	Quiſſa	12	25	N	307	30
	Eaſt-end of *Hiſpaniola*	18	47	N	308	10
	Weſt-end of *Hiſpaniola*	18	25	N	300	10
	Port Royal in *Jamaica*	18	15	N	297	10
	Eaſt-end of Cuba	20	27	N	301	20
	Weſt-end of *Cuba*	22	00	N	288	26
	Cannamis	19	41	N	294	45
	Great Caiman	19	21	N	293	30
	Santa Villa	17	28	N	294	00
	Moſquito	14	50	N	294	12
	Guanabo	16	33	N	287	14
	Guanabimo	16	10	N	286	20
	Cezumal	19	25	N	287	10
	Laſalleiranes	22	00	N	284	40

	Places Names.	Latitude.			Longit.	
		D.	M.		D.	M.
The Northern Parts of *America.*	*Cape Camas*	53	40	N	226	52
	Reſolution Iſles	61	00	N	309	00
	The King's Foreland	61	50	N	295	30
	Queen *Ann's Foreland*	63	52	N	293	40
	Cape Charles	62	55	N	291	42
	North-end of *Mansfield's Iſle*	62	40	N	284	39
	Prince *Rupert's River*	51	00	N	289	12
	Cape Monmouth	54	40	N	283	00
	Cape Henrietta	56	16	N	279	10
	Port Nelſon	58	32	N	267	50
	Cape Southampton	62	30	N	279	25
	Seahorſe Point	64	46	N	282	20
	Sir *Dudley Digg's Cape*	75	10	N	298	00
	Sanderſon's Tower	68	00	N	314	08
	Cape Walſingham	65	42	N	311	20
	Cape Comfort	62	21	N	321	20
	Cape Deſolation	61	20	N	325	05
	Cape Farewel.	59	45	N	329	02

The Uſe of the Table of Latitudes and Longitudes of Places.

IN this *Table* there are two Columns, the one ſhewing the Latitude, the other the Longitude of Places: The Latitudes are diſtinguiſhed by the Letters N and S, which ſhew the Latitude of the Place to be either Northerly or Southerly. The Longitudes are all accounted Eaſterly, from the Meridian of *Pico* on the Iſland of *Teneriff.* An Example or two will make it plain.

Example 1.

What is the Latitude and Longitude of the Lizard, *upon the Coaſt of* England?

Againſt the *Lizard*, you will find 50° 00′ North Latitude, and 12° 37′ of Longitude.

Example 2.

What is the Latitude and Longitude of *Bermudas*, one of the *Weſt-India* Iſlands?

Againſt *Bermudas* you will find Lat. 32° 18′ N. Long. 310° 50′.

2. To find the Difference of Longitude between any two Places.

Take the Longitudes of the two Places out of the Tables, and ſubtract the leſſer Longitude out of the greater; and if the Remainder be leſs than 180°, that is the Diff. of Long. but if the Remainder be more than 180°, ſubtract it from 360°, the laſt Remainder is the Diff. of Long.

Example 1.

What is the Difference of Longitude between *Bermudas*, and *Cape Raze* in *New-found Land*?

The Longitude of *Cape Raze* is ——— 328° 30′
of *Bermudas*, ——— 310 50
The Remainder is the Diff. of Longitude ——— 17 40

Example 2.

What is the Difference of Longitude between the *Lizard* and *Cape Raze*.

The Longitude of *Cape Raze* is ——— 328° 30′
of the *Lizard*, ——— 12 37
The Remainder is greater than 180° ——— 315 53
Therefore ſubtract it from ——— 300 00
The laſt Remainder is the Difference of Longit. —— 44 07

3. To know whether the Longitude between any two Places be Eaſterly or Weſterly.

1. When the Remainder firſt found is leſs than 180°, then if you are bound to that Place which hath the leſs Longitude, your Diff. of Long. is Weſterly; and therefore you muſt ſail to the Weſtward: but if you are bound to that which hath the greater, your Diff. of Long. is Eaſterly, and you muſt ſail thither Eaſtward.

2. When the firſt Remainder is greater than 180°, then if you ſail to that Place, having the greater Longitude, your Diff. of Longit. is Weſterly; if to that which hath the leſs, Eaſterly.

Here followeth a Table of Meridional Parts.

M	o d.	1 d.	2 d.	3 d.	4 d.	5 d.	6 d.	7 d.	8 d.	9 d.	10 d	M
0	0	60	120	180	240	300	361	421	481	542	603	0
1	1	61	121	181	241	301	362	422	482	543	604	1
2	2	62	122	182	242	302	363	423	483	544	605	2
3	3	63	123	183	243	303	364	424	484	545	606	3
4	4	64	124	184	244	304	365	425	485	546	607	4
5	5	65	125	185	245	305	366	426	486	547	608	5
6	6	66	126	186	246	306	367	427	488	548	609	6
7	7	67	127	187	247	307	368	428	489	549	610	7
8	8	68	128	188	248	308	369	429	490	550	611	8
9	9	69	129	189	249	309	370	430	491	551	612	9
10	10	70	130	190	250	310	371	431	492	552	613	10
11	11	71	131	191	251	311	372	432	493	553	614	11
12	12	72	132	192	252	312	373	433	494	554	615	12
13	13	73	133	193	253	313	374	434	495	555	616	13
14	14	74	134	194	254	314	375	435	496	556	617	14
15	15	75	135	195	255	315	376	436	497	557	618	15
16	16	76	136	196	256	316	377	437	498	558	619	16
17	17	77	137	197	257	317	378	438	499	559	620	17
18	18	78	138	198	258	318	379	439	500	560	621	18
19	19	79	139	199	259	319	380	440	501	561	622	19
20	20	80	140	200	260	320	381	441	502	562	623	20
21	21	81	141	201	261	321	382	442	503	563	624	21
22	22	82	142	202	262	322	383	443	504	564	625	22
23	23	83	143	203	263	323	384	444	505	565	626	23
24	24	84	144	204	264	324	385	445	506	566	627	24
25	25	85	145	205	265	325	386	446	507	567	628	25
26	26	86	146	206	266	326	387	447	508	568	629	26
27	27	87	147	207	267	327	388	448	509	569	630	27
28	28	88	148	208	268	228	389	449	510	570	631	28
29	29	89	149	209	269	329	390	450	511	571	632	29
30	30	90	150	210	270	330	391	451	512	573	633	30
31	31	91	151	211	271	331	392	452	513	574	634	31
32	32	92	152	212	272	332	293	453	514	575	635	32
33	33	93	153	213	273	333	394	454	515	576	636	33
34	34	94	154	214	274	334	395	455	516	577	638	34
35	35	95	155	215	275	335	396	456	517	578	639	35
36	36	96	156	216	276	336	397	457	518	579	640	36
37	37	97	157	217	277	337	398	458	519	580	641	37
38	38	98	158	218	278	338	399	459	520	581	642	38
39	39	99	159	219	279	339	300	460	521	582	643	39
40	40	100	160	220	280	340	401	461	522	583	644	40
41	41	101	161	221	281	341	402	462	523	584	645	41
42	42	102	162	222	282	342	403	463	524	585	646	42
43	43	103	163	223	283	343	404	464	525	586	647	43
44	44	104	164	224	284	344	405	465	526	587	648	44
45	45	105	165	225	285	345	406	466	527	588	649	45
46	46	106	166	226	286	346	407	467	528	589	650	46
47	47	107	167	227	287	347	408	468	529	590	651	47
48	48	108	168	228	288	348	409	469	530	591	652	48
49	49	109	169	229	289	349	410	470	531	592	653	49
50	50	110	170	230	290	350	411	471	532	593	654	50
51	51	111	171	231	291	351	412	472	533	594	655	51
52	52	112	172	222	292	353	413	473	534	595	656	52
53	53	113	173	233	293	354	414	474	535	596	657	53
54	54	114	174	234	294	355	415	475	536	597	658	54
55	55	115	175	235	295	356	416	476	537	598	659	55
56	56	116	176	236	296	357	417	477	538	599	660	56
57	57	117	177	237	297	358	418	478	539	600	661	57
58	58	118	178	238	298	359	419	479	540	601	662	58
59	59	119	179	239	299	360	420	480	541	602	663	59

M	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d	21 d	M
0	604	725	787	848	910	973	1035	1098	1161	1225	1289	0
1	665	726	788	849	911	974	36	99	62	26	90	1
2	666	727	789	850	912	975	37	1100	63	27	91	2
3	667	728	790	851	913	976	38	01	65	28	92	3
4	668	729	791	852	914	977	39	02	66	29	93	4
5	669	730	792	854	916	978	40	03	67	30	94	5
6	670	731	793	855	917	979	41	04	68	31	95	6
7	671	732	794	856	918	980	42	05	69	32	97	7
8	672	733	795	857	919	981	44	07	70	34	98	8
9	673	734	796	858	920	982	45	08	71	35	99	9
10	674	735	797	859	921	983	1046	1109	1172	1236	1300	10
11	675	736	798	860	922	984	47	10	73	37	01	11
12	676	737	799	861	923	985	48	11	74	38	02	12
13	677	738	800	862	924	986	49	12	75	39	03	13
14	678	740	801	863	925	987	50	13	76	40	04	14
15	679	741	802	864	926	988	51	14	77	41	05	15
16	680	742	803	865	927	989	52	15	78	42	06	16
17	681	743	804	866	928	990	53	16	79	43	07	17
18	682	744	805	867	929	991	54	17	80	44	08	18
19	683	745	806	868	930	992	55	18	81	45	09	19
20	684	746	807	869	931	993	1056	1119	1183	1246	1311	20
21	685	747	808	870	932	994	57	20	84	47	12	21
22	686	748	809	871	933	995	58	21	85	48	13	22
23	687	749	810	872	934	997	59	22	86	50	14	23
24	688	750	811	873	935	998	60	23	87	51	15	24
25	689	751	812	874	936	999	61	24	88	52	16	25
26	690	752	813	875	937	1000	62	25	89	53	17	26
27	691	753	814	876	938	1001	63	27	90	54	18	27
28	692	754	815	877	939	1002	64	28	91	55	19	28
29	694	755	816	878	940	1003	66	29	92	56	20	29
30	695	756	817	879	941	1004	1067	1130	1193	1257	1321	30
31	696	757	819	880	942	05	68	31	94	58	22	31
32	697	758	820	881	944	06	69	32	95	59	23	32
33	698	759	821	882	945	07	70	33	96	60	25	33
34	699	760	822	883	946	08	71	34	97	61	26	34
35	700	761	823	884	947	09	72	35	98	62	27	35
36	701	762	824	886	948	10	73	36	1200	63	28	36
37	702	763	825	887	949	11	74	37	01	64	29	37
38	703	764	826	888	950	12	75	38	02	65	30	38
39	704	765	827	889	951	13	76	39	03	67	31	39
40	705	766	828	890	952	1014	1077	1140	1204	1268	1332	40
41	706	767	829	891	953	15	78	41	05	69	33	41
42	707	768	830	892	954	16	79	42	06	70	34	42
43	708	769	831	893	955	17	80	43	07	71	35	43
44	709	770	832	894	956	18	81	44	08	72	36	44
45	710	771	833	895	957	20	82	46	09	73	37	45
46	711	772	834	896	958	21	83	47	10	74	38	46
47	712	773	835	897	959	22	84	48	11	75	40	47
48	713	774	836	898	960	23	85	49	12	76	41	48
49	714	775	827	899	961	24	87	50	13	77	42	49
50	715	776	838	900	962	1025	1088	1151	1214	1278	1343	50
51	716	777	839	901	963	26	89	52	15	79	44	51
52	717	778	840	902	964	27	90	53	16	81	45	52
53	718	779	841	903	965	28	91	54	18	82	46	53
54	719	780	842	904	966	29	92	55	19	83	47	54
55	720	782	843	905	967	30	93	56	20	84	48	55
56	721	783	844	906	968	31	94	57	21	85	49	56
57	722	784	845	907	969	32	95	58	22	86	50	57
58	723	785	846	908	971	33	96	59	23	87	51	58
59	724	786	847	909	972	34	97	60	24	88	52	59

M	22 *d*	23 *d*	24 *d*	25 *d*	26 *d*	27 *d*	28 *d*	29 *d*	30 *d*	31 *d*	32 *d*	M
0	1354	1419	1484	1550	1616	1683	1751	1819	1888	1958	2028	0
1	55	20	85	51	17	85	52	20	89	59	29	1
2	56	21	86	52	19	86	53	22	9	60	31	2
3	57	22	87	53	20	87	54	23	92	61	32	3
4	58	23	88	54	21	88	56	24	93	63	33	4
5	59	24	89	55	22	89	57	25	94	64	34	5
6	60	25	91	57	23	90	58	26	95	65	35	6
7	61	26	92	58	24	91	59	27	9	66	37	7
8	62	27	93	59	25	93	60	28	9	67	38	8
9	63	28	94	60	26	94	61	30	99	68	39	9
10	1364	1429	1495	1561	1628	1695	1762	1831	190	1970	2040	10
11	65	30	96	62	29	96	64	32	01	71	41	11
12	67	31	97	63	30	97	65	33	0	72	42	12
13	68	33	98	64	31	98	66	34	0	73	44	13
14	69	34	99	65	32	99	67	35	0	74	45	14
15	70	35	1500	66	33	1700	68	37	0	75	46	15
16	71	36	01	68	34	01	69	38	07	77	47	16
17	72	37	03	69	35	03	70	39	0	78	48	17
18	73	38	04	70	36	04	71	40	0	79	50	18
19	74	39	05	71	38	05	73	41	1	80	51	19
20	1375	1440	1506	1572	1639	1706	1774	1842	191	981	2052	20
21	76	41	07	73	40	07	75	43	13	82	52	21
22	77	42	08	74	41	08	76	45	[illegible]	84	54	22
23	78	44	09	75	42	09	77	46	1	85	55	23
24	79	45	10	76	43	10	78	47	16	86	57	24
25	81	46	11	78	44	12	79	48	17	87	58	25
26	82	47	12	79	45	13	81	49	1	88	59	26
27	83	48	14	80	46	14	82	50	2	89	60	27
28	84	49	15	81	48	15	83	51	2	91	61	28
29	85	50	16	82	49	16	84	53	2	92	63	29
30	1386	1451	1517	1583	1650	1717	1785	1854	192	993	2064	30
31	87	52	18	84	51	18	86	55	2	94	65	31
32	88	53	19	85	52	19	87	56	2	95	66	32
33	89	54	20	86	53	21	89	57	2	97	67	33
34	90	56	21	87	54	22	90	58	28	98	69	34
35	91	57	22	89	55	23	91	59	29	99	70	35
36	92	58	23	90	57	24	92	61	30	000	71	36
37	94	59	25	91	58	25	93	62	31	01	72	37
38	95	60	26	92	59	26	94	63	32	02	73	38
39	96	61	27	93	60	27	95	64	3	04	74	39
40	1397	1462	1528	1594	1661	1728	1797	1865	1935	2005	2076	40
41	98	63	29	95	62	30	98	66	3	06	77	41
42	99	64	30	96	63	31	99	68	37	07	78	42
43	1400	65	31	97	64	32	1800	69	38	08	79	43
44	01	66	32	99	65	33	01	70	3	09	80	44
45	02	68	33	1600	67	34	02	71	4	11	82	45
46	03	69	34	01	68	35	03	72	4	12	83	46
47	04	70	36	02	69	36	04	73	43	13	84	47
48	05	71	37	03	70	37	06	74	44	14	85	48
49	07	72	38	04	71	39	07	76	45	15	86	49
50	1408	1473	1539	1605	1672	1740	1808	1877	1946	2017	2088	50
51	09	74	40	06	73	41	09	78	47	18	89	51
52	10	75	41	07	74	42	10	79	49	19	90	52
53	11	76	42	09	76	43	11	80	50	20	91	53
54	12	77	43	10	77	44	12	81	51	21	92	54
55	13	78	44	11	78	45	14	83	52	22	93	55
56	14	80	45	12	79	47	15	84	53	24	95	56
57	15	81	47	13	80	48	16	85	54	25	96	57
58	16	82	48	14	81	49	17	86	56	26	97	58
59	17	83	49	15	82	50	18	87	57	27	98	59

M	33 d	34 d	35 d	36 d	37 d	38 d	39 d	40 d	41 d	42 d	43 d	M
0	20 9	2171	2244	2318	2393	2466	2545	2623	2702	2782	2863	0
1	2101	73	45	19	94	69	46	24	03	83	64	1
2	02	74	47	20	95	71	47	25	04	84	66	2
3	03	75	48	22	96	72	49	27	06	86	67	3
4	04	76	49	23	98	73	50	28	07	87	69	4
5	05	77	50	24	99	75	51	29	08	88	70	5
6	07	79	52	25	2400	76	53	30	10	90	71	6
7	08	80	53	27	01	77	54	32	11	91	73	7
8	09	81	54	28	03	78	55	33	12	92	74	8
9	10	82	55	29	04	80	56	34	14	94	75	9
10	2111	2183	2256	2330	2405	2481	2558	2636	2715	2795	2877	10
11	13	85	58	32	06	82	59	37	16	97	78	11
12	14	86	59	33	08	83	60	38	17	98	80	12
13	15	87	60	34	09	85	62	40	19	99	81	13
14	16	88	61	35	10	86	63	41	20	2801	82	14
15	17	90	63	36	11	87	64	42	21	02	84	15
16	19	91	64	38	13	89	66	44	2.	03	85	16
17	20	92	65	39	14	90	67	45	2.	05	86	17
18	21	93	66	40	15	91	68	46	25	06	88	18
19	22	94	67	41	16	92	69	48	27	07	89	19
20	2123	2196	2269	2343	2418	2494	2571	2649	2728	2809	2890	20
21	25	97	70	44	19	95	72	50	29	10	92	21
22	26	98	71	45	20	96	73	51	31	11	93	22
23	27	99	72	46	21	97	75	53	32	13	95	23
24	28	2200	74	48	23	99	76	54	33	14	96	24
25	39	02	75	49	24	2500	77	55	35	15	97	25
26	31	03	76	50	25	01	78	57	36	17	99	26
27	32	04	77	51	26	03	80	58	37	18	2900	27
28	33	05	78	53	28	04	8	59	39	20	02	28
29	24	06	80	54	29	05	8	61	40	21	03	29
30	2135	2208	2281	2355	2430	2506	2584	2662	2741	2822	2904	30
31	37	09	82	56	32	08	85	63	43	24	06	31
32	38	10	83	58	33	09	86	65	44	25	07	32
33	39	11	85	59	34	10	88	66	45	26	08	33
34	40	13	86	60	35	12	89	67	47	28	10	34
35	41	14	87	61	37	13	90	69	48	29	11	35
36	43	15	88	63	38	14	91	70	49	30	13	36
37	44	16	90	64	39	15	93	71	51	32	14	37
38	45	17	91	65	40	17	9	73	52	33	15	38
39	46	19	92	66	42	18	95	74	54	34	17	39
40	2147	2220	2293	2368	2443	2519	2597	2675	2755	2836	2918	40
41	49	21	94	69	44	20	98	76	56	37	19	41
42	50	22	96	70	45	22	99	78	58	39	21	42
43	51	23	97	71	47	23	2601	79	59	40	22	43
44	52	25	98	73	48	24	02	80	60	41	24	44
45	53	26	99	74	49	26	03	82	61	43	25	45
46	55	27	2301	75	50	27	04	83	63	44	26	46
47	56	28	02	76	52	28	06	84	64	45	28	47
48	57	30	03	78	53	29	07	86	66	47	29	48
49	58	31	04	79	54	31	08	87	67	48	31	49
50	59	2232	2306	2380	2456	2532	2610	688	2768	2849	2932	50
51	61	33	07	81	57	33	11	90	70	51	33	51
52	62	34	08	83	58	35	12	91	71	52	35	52
53	63	36	09	84	59	36	14	92	72	54	36	53
54	64	37	11	85	61	37	15	94	74	55	37	54
55	65	38	12	86	62	38	16	95	75	56	39	55
56	67	39	13	88	63	40	17	96	76	58	40	56
57	68	41	14	89	64	41	19	98	78	59	42	57
58	69	42	15	90	66	42	20	99	79	60	43	58
59	70	43	17	91	67	44	21	2700	80	62	4	59

M	44d	45d	46d	47d	48d	49d	50d	51d	52d	53d	54d	M
0	2946	3030	3116	3203	3292	3382	3475	3569	3665	3765	3865	0
1	47	31	17	04	93	84	76	70	67	67	66	1
2	49	33	18	06	95	85	78	72	69	69	68	2
3	50	34	20	07	96	87	79	74	70	70	70	3
4	51	36	21	09	98	88	81	75	72	72	72	4
5	53	37	23	10	99	90	82	77	73	73	73	5
6	54	38	24	12	3301	91	84	78	75	75	75	6
7	56	40	26	13	02	93	85	80	77	77	77	7
8	57	41	27	14	04	94	87	82	78	78	78	8
9	58	42	29	16	05	96	89	83	80	79	80	9
10	2960	3044	3130	3217	3307	3397	3490	3585	3682	3780	3882	10
11	61	46	31	19	08	99	92	86	83	82	83	11
12	63	47	33	20	10	3400	93	88	85	84	85	12
13	64	48	34	22	12	02	95	90	87	85	87	13
14	65	50	36	23	13	03	96	91	88	87	89	14
15	67	51	37	25	14	05	98	93	90	89	90	15
16	68	53	39	26	16	07	99	94	91	91	92	16
17	69	54	40	28	17	08	3501	96	93	92	94	17
18	71	55	42	29	19	10	03	98	95	94	95	18
19	72	57	43	31	20	11	04	99	96	96	97	19
20	2974	3058	3144	3232	3322	3413	3506	3600	3698	3797	3899	20
21	75	60	46	34	23	14	07	02	3700	99	3901	21
22	76	61	47	35	25	16	09	04	01	3801	02	22
23	78	63	49	37	26	17	10	06	03	02	04	23
24	79	64	50	38	28	19	12	07	05	04	06	24
25	81	65	52	40	29	20	14	09	06	06	07	25
26	82	67	53	41	31	22	15	10	08	07	09	26
27	83	68	55	42	32	23	17	12	09	09	11	27
28	85	70	56	44	34	25	18	14	11	11	13	28
29	86	71	57	45	35	27	20	15	13	12	14	29
30	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	30
31	89	74	60	48	38	30	23	18	16	16	18	31
32	90	75	62	50	40	31	25	20	18	17	20	32
33	92	77	63	51	41	33	26	22	19	19	21	33
34	93	78	65	53	43	34	28	23	21	21	23	34
35	95	80	66	54	44	36	29	25	23	22	25	35
36	96	81	68	56	46	37	31	26	24	24	26	36
37	98	83	69	57	47	39	32	28	26	26	28	37
38	99	84	71	59	49	40	34	30	28	27	30	38
39	3000	85	72	60	50	42	36	31	29	29	32	39
40	3002	3087	3173	3262	3352	3443	3537	3633	3731	3831	3933	40
41	03	88	75	63	53	45	39	35	32	33	35	41
42	05	90	76	65	55	47	40	36	34	34	37	42
43	06	91	78	66	56	48	42	38	36	36	39	43
44	07	93	79	68	58	49	43	39	37	38	40	44
45	09	94	81	69	59	51	45	41	39	39	42	45
46	10	95	82	71	61	53	47	43	41	41	44	46
47	12	97	84	72	62	54	48	44	42	43	45	47
48	13	98	85	74	64	56	50	46	44	44	47	48
49	14	3100	87	75	65	57	51	48	46	46	49	49
50	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	50
51	17	03	90	78	68	61	55	51	49	49	52	51
52	19	04	91	80	70	62	56	52	51	51	54	52
53	20	05	92	81	71	64	58	54	52	53	56	53
54	22	07	94	83	73	65	59	56	54	55	58	54
55	23	08	95	84	74	67	61	57	56	56	59	55
56	24	10	97	86	76	68	62	59	57	58	61	56
57	26	11	98	87	78	70	64	60	59	60	63	57
58	27	13	3200	89	79	71	66	62	61	61	65	58
59	29	14	01	90	81	73	67	64	62	63	66	59

M	55 d	56 d	57 d	58 d	59 d	60 d	61 d	62 d	63 d	64 d	65 d	M
0	3968	4074	4183	4294	4409	4528	4649	4775	4905	5040	5179	0
1	70	76	85	96	11	30	52	77	07	42	82	1
2	72	78	86	98	13	32	54	80	10	44	84	2
3	73	79	88	4300	15	34	56	82	12	47	86	3
4	75	81	90	02	17	36	58	84	14	49	89	4
5	77	83	92	04	19	38	60	86	16	51	91	5
6	79	85	94	06	21	40	62	88	19	53	93	6
7	80	87	96	08	23	42	64	90	21	56	96	7
8	82	88	97	10	25	44	66	92	23	58	98	8
9	84	90	99	12	27	46	68	95	25	60	5201	9
10	3986	4092	4201	4313	4429	4548	4670	4797	4927	5063	5203	10
11	87	94	03	15	31	50	72	99	30	65	05	11
12	89	97	05	17	33	52	74	4801	32	67	08	12
13	91	99	07	19	35	54	76	03	34	70	10	13
14	93	4100	09	21	37	56	78	05	36	72	12	14
15	94	01	10	23	39	58	81	07	38	74	15	15
16	96	03	12	25	41	60	83	10	41	76	17	16
17	98	05	14	27	43	62	85	12	43	79	20	17
18	4000	06	16	29	44	64	87	14	45	81	22	18
19	01	08	18	31	46	66	89	16	47	83	24	19
20	4003	4110	4220	4332	4448	4568	4691	4818	4950	5086	5227	20
21	05	12	22	34	50	70	93	20	52	88	29	21
22	07	14	23	36	52	72	95	22	54	90	32	22
23	08	15	25	38	54	74	97	25	56	93	34	23
24	10	17	27	40	56	76	99	27	59	95	36	24
25	12	19	29	42	58	78	4701	29	61	97	39	25
26	14	21	31	44	60	80	04	31	63	5100	41	26
27	15	23	33	46	62	82	06	33	65	02	44	27
28	17	24	35	48	64	84	08	35	67	04	46	28
29	19	26	36	50	66	86	10	38	70	07	48	29
30	4021	4128	4238	4352	4468	4588	4712	4840	4972	5109	5251	30
31	22	30	40	53	70	90	14	42	74	11	53	31
32	24	32	42	55	72	92	16	44	76	14	56	32
33	26	33	44	57	74	94	18	46	79	16	58	33
34	28	35	46	59	76	96	20	48	81	18	61	34
35	30	37	48	61	78	98	22	51	83	20	63	35
36	31	39	49	63	80	4600	24	53	85	23	65	36
37	33	41	51	65	82	02	27	55	88	25	68	37
38	35	43	53	67	84	04	29	57	90	27	70	38
39	57	44	55	69	86	06	31	59	92	30	73	39
40	4038	4146	4257	4371	4488	4608	4733	4861	4994	5132	5275	40
41	40	48	59	73	90	10	35	64	97	35	78	41
42	42	50	61	75	92	13	37	66	99	37	80	42
43	44	52	63	77	94	15	39	68	5001	39	83	43
44	46	54	64	78	96	17	41	70	03	42	85	44
45	47	55	66	80	98	19	43	72	06	44	87	45
46	49	57	68	82	4500	21	46	75	08	46	90	46
47	51	59	70	84	02	23	48	77	10	49	92	47
48	53	61	72	86	04	25	50	80	12	51	95	48
49	54	63	74	88	06	27	52	81	15	53	97	49
50	4056	4164	4276	4390	4508	4629	4754	4883	5017	5156	5299	50
51	58	66	78	92	10	31	56	85	20	58	5302	51
52	60	68	79	94	12	33	58	88	22	60	04	52
53	62	70	81	96	14	35	60	90	24	63	07	53
54	63	72	83	98	16	37	63	92	26	65	09	54
55	65	74	85	4400	18	38	65	94	28	67	12	55
56	67	75	87	02	20	41	67	96	31	70	14	56
57	69	77	89	04	22	43	69	99	33	72	17	57
58	70	79	91	05	24	45	71	4901	35	74	19	58
59	72	81	93	07	26	47	73	03	38	77	21	59

M	66 d	67 d	68 d	69 d	70 d	71 d	72 d	73 d	74 d	75 d	76 d	M
0	5324	5474	5631	5795	5967	6146	6336	6535	6747	6971	7211	0
1	26	77	34	98	70	50	39	39	50	75	15	1
2	29	80	37	5801	72	53	42	42	54	79	20	2
3	31	82	39	04	75	56	45	46	58	83	24	3
4	34	85	42	06	78	59	49	49	61	87	28	4
5	36	87	45	09	81	62	52	52	65	91	32	5
6	39	90	47	12	84	65	55	56	69	95	36	6
7	41	92	52	15	87	68	58	59	72	99	40	7
8	44	95	53	18	90	71	62	63	76	7003	45	8
9	46	98	55	20	93	74	65	66	78	06	49	9
10	5349	5500	5658	5823	5996	6177	6368	6570	6783	7010	7253	10
11	51	03	61	26	99	80	71	73	87	14	57	11
12	54	05	64	29	6002	83	75	77	91	18	61	12
13	56	08	66	32	05	87	78	80	94	22	65	13
14	59	11	69	34	08	90	81	84	98	26	70	14
15	61	13	72	37	11	93	85	87	6802	30	74	15
16	64	16	74	40	14	96	88	90	05	34	78	16
17	66	18	77	43	17	99	91	94	09	38	82	17
18	68	21	80	46	20	6202	94	97	13	42	87	18
19	71	23	82	49	23	05	98	6601	16	46	91	19
20	5373	5526	5685	5851	6026	6208	6401	1605	6820	7050	7295	20
21	76	29	88	54	29	12	04	08	24	54	99	21
22	78	31	91	57	32	15	08	11	27	58	7303	22
23	81	34	93	60	34	18	11	15	31	61	08	23
24	83	37	96	63	38	21	14	18	35	65	12	24
25	86	39	99	66	40	24	18	22	39	69	16	25
26	88	42	5701	68	43	27	21	25	42	73	21	26
27	91	44	04	71	46	30	24	29	46	77	25	27
28	93	47	07	74	49	34	27	32	50	81	29	28
29	96	49	10	77	52	37	31	36	54	85	33	29
30	5398	5552	5712	5880	6055	6240	6434	6639	6857	7089	7338	30
31	5401	55	15	83	58	43	37	43	61	93	42	31
32	03	57	18	86	61	46	41	47	65	97	46	32
33	06	60	21	88	64	49	44	51	69	7101	50	33
34	09	63	23	91	67	52	47	54	72	05	55	34
35	11	65	26	94	70	56	51	57	76	09	59	35
36	14	68	29	97	73	59	54	61	80	13	63	36
37	16	70	32	5900	76	62	57	64	84	17	68	37
38	19	73	34	03	79	65	61	68	87	21	72	38
39	21	76	37	06	82	68	64	71	91	26	76	39
40	5424	5578	5740	5909	6085	6271	6468	6675	6895	7130	7381	40
41	26	81	42	11	89	75	71	78	99	34	85	41
42	29	84	45	14	92	78	74	82	6903	38	89	42
43	31	86	48	17	95	81	78	86	06	42	94	43
44	34	89	51	20	98	84	81	89	10	46	98	44
45	36	92	54	23	6101	87	84	93	14	50	7403	45
46	39	94	56	26	04	91	88	96	18	54	07	46
47	41	97	59	29	07	94	91	6700	22	58	11	47
48	44	99	62	32	10	97	94	03	25	62	16	48
49	46	5602	65	35	13	6300	98	07	29	66	20	49
50	5449	5605	5767	5937	6116	6303	6501	6711	6933	7170	7424	50
51	52	07	70	40	20	07	05	14	37	74	29	51
52	54	10	73	43	22	10	08	18	41	78	33	52
53	58	13	76	46	25	13	11	21	44	82	38	53
54	59	15	78	49	28	16	15	25	48	87	42	54
55	62	18	81	52	31	19	18	29	52	91	46	55
56	64	21	84	55	34	23	22	32	56	95	51	56
57	67	23	87	58	37	26	25	36	60	99	55	57
58	69	26	90	61	40	29	28	39	64	7203	59	58
59	72	29	92	64	43	32	32	43	68	07	64	59

M	77 d.	78 d.	79 d.	80 d.	81 d.	82 d.	83 d.	84 d.	85 d.	M
0	7469	7746	8047	8377	8741	9148	9609	10148	10770	0
1	73	51	53	83	48	55	17	150	781	1
2	78	56	58	89	54	63	20	160	793	2
3	82	61	63	95	61	70	34	170	804	3
4	86	65	69	8400	67	77	42	179	816	4
5	91	70	74	06	74	84	50	189	827	5
6	95	75	79	12	80	92	59	199	839	6
7	7500	80	84	18	87	99	67	209	851	7
8	04	85	90	24	93	9206	75	218	863	8
9	09	90	95	30	99	14	84	228	875	9
10	7513	7795	8100	8435	8806	9221	9692	10238	10886	10
11	18	99	06	41	13	28	9701	248	899	11
12	22	7804	11	47	19	36	09	258	910	12
13	27	09	16	53	26	43	18	268	922	13
14	31	14	22	59	32	50	26	278	934	14
15	36	19	27	65	39	58	35	288	946	15
16	40	24	32	71	45	65	43	298	958	16
17	45	29	38	77	52	73	52	308	971	17
18	50	34	43	83	59	80	60	318	983	18
19	54	39	49	89	65	88	69	328	995	19
20	7559	7844	8154	8494	8872	9295	9777	10338	11007	20
21	63	49	59	8500	78	9303	86	348	020	21
22	68	54	65	06	85	10	95	358	032	22
23	72	59	70	12	92	18	9803	368	047	23
24	77	64	76	18	98	25	12	378	058	24
25	82	69	81	24	8905	33	21	389	070	25
26	86	75	87	30	12	40	30	399	082	26
27	91	79	92	36	19	48	38	410	095	27
28	95	84	98	42	25	56	47	420	107	28
29	7600	89	8203	49	32	63	56	430	120	29
30	7605	7894	8208	8555	8939	9371	9865	10441	11133	30
31	09	99	14	61	46	79	74	451	146	31
32	14	7904	19	67	52	86	82	462	158	32
33	19	09	25	73	59	94	91	472	171	33
34	23	14	31	79	66	9402	9900	483	184	34
35	28	19	36	85	73	10	09	494	197	35
36	32	24	42	91	80	17	18	504	210	36
37	37	29	47	97	87	25	27	515	223	37
38	42	34	53	8603	93	33	36	526	236	38
39	46	39	58	10	9000	41	45	536	258	39
40	7651	7944	8264	8616	9007	9449	9954	10547	11263	40
41	56	49	69	22	14	56	63	558	276	41
42	61	54	75	28	21	64	73	569	289	42
43	65	59	80	34	28	72	82	579	303	43
44	70	65	86	41	35	80	92	590	316	44
45	75	70	92	47	42	88	10000	601	330	45
46	79	75	97	53	49	96	09	612	343	46
47	84	80	8303	59	56	9504	18	623	357	47
48	89	85	09	65	63	12	28	634	371	48
49	94	90	15	72	70	20	37	645	384	49
50	7698	7995	8320	8678	9077	9528	10046	10656	11398	50
51	7703	8001	26	84	84	36	056	668	412	51
52	08	06	31	91	91	44	065	679	426	52
53	13	11	37	97	98	52	074	690	440	53
54	17	16	43	8703	9105	60	084	701	454	54
55	22	21	49	10	12	68	093	713	468	55
56	27	27	54	16	20	76	103	724	482	56
57	32	32	60	22	27	85	112	735	496	57
58	37	37	66	29	34	93	122	747	510	58
59	41	42	71	35	41	9601	131	758	525	59

M	86 *d.*	87 *d.*	88 *d.*	89 *d.*	M
0	11539	12521	13920	16317	0
1	553	540	949	376	1
2	568	559	978	435	2
3	582	579	14007	495	3
4	597	598	037	557	4
5	611	618	067	619	5
6	626	638	097	683	6
7	641	658	127	748	7
8	656	678	158	814	8
9	671	698	189	881	9
10	11686	12718	14220	16950	10
11	701	738	252	17020	11
12	716	759	284	092	12
13	731	779	316	165	13
14	746	800	348	240	14
15	761	821	381	310	15
16	777	842	414	394	16
17	792	863	448	474	17
18	808	884	481	556	18
19	823	906	515	640	19
20	11839	12027	14550	17726	20
21	855	949	584	814	21
22	870	970	619	904	22
23	886	992	655	997	23
24	902	13014	691	18093	24
25	918	037	727	191	25
26	934	059	764	292	26
27	950	081	800	396	27
28	967	104	838	503	28
29	983	127	876	615	29
30	11999	13150	14914	18729	30
31	12016	172	952	848	31
32	032	196	992	971	32
33	049	219	15031	19098	33
34	066	243	071	230	34
35	086	267	111	368	35
36	099	294	152	511	36
37	116	315	194	660	37
38	133	339	236	817	38
39	150	363	278	980	39
40	12167	13388	15321	20152	40
41	185	413	365	333	41
42	202	437	409	524	42
43	220	463	453	726	43
44	237	488	499	941	44
45	255	513	545	21170	45
46	273	539	591	416	46
47	290	565	638	680	47
48	308	591	686	967	48
49	326	617	734	22279	49
50	12344	13643	15183	22623	50
51	363	670	833	23005	51
52	381	697	884	23435	52
53	399	724	935	23926	53
54	408	751	987	24499	54
55	426	779	16040	25786	55
56	445	807	094	26046	56
57	464	834	148	27192	57
58	483	863	204	28911	58
59	502	891	260	32348	59

The Uſe of the Table of Meridional Parts.

IN this Table, the Left-hand Column upon every Page under M. beginning at 1, and ending at 59, contains the Minutes anſwering to every degree of Latitude. The other Columns, diſtinguiſhed by 1 *d.* 2 *d.*&c. to 89 *d.* contain the Meridional Parts anſwering to every degree of Latitude. The Uſe of theſe Columns together, is to find the Meridional Parts for every degree and minute of Latitude. An Example or two will ſufficiently explain it.

Example 1.

The Latitude of 51 deg. 12 min. to find the Meridional Parts.

In the Column under 51 *d.* and right againſt 12 M. in the Left-hand Column ſtands 88, and joining 35, the two Figures in the ſame Column, that ſtands next above 88, towards the Left-hand, the whole is 3588, the Meridional Parts required.

Example 2.

The Latitude of 87 deg. 52 min. to find the Meridional Parts.

In the Column under 87 *d.* and right againſt 52 M. in the Left-hand Column ſtands 697, to which joining 13 towards the Left-hand, the whole is 13695, the Meridional Parts required.

The Uſe of theſe Meridional Parts are ſhewn in the firſt Problem of *Mercator's* Sailing, *Chap. 6.*

A New and Exact KALENDAR, *ſhewing the* Prime, Epact, Dominical Letters, *and* Leap-Years, *for Twenty three Years: Alſo the Days of the Month, and Remarkable Days; with Tables of the Sun's true Place in the Ecliptick, and the Declination of the Sun for four Years to come; and may indifferently ſerve for many more.*

Years	Prime.	Epact.	Dom. Let.	Cycl. ☉.	Shrove-Sunday.	Easter-Sunday.	Whit-Sunday.
1694	4	14	G	23	*February* 18	*April* 8	*May* 27
1695	5	25	F	24	*March* 3	25	12
1696	6	6	E D	25	*February* 23	12	31
1697	7	17	C	26	14	4	23
1698	8	28	B	27	*March* 6	2	*June* 12
1699	9	9	A	28	*February* 19	9	*May* 28
1700	10	20	G F	1	10	*March* 31	19
1701	11	1	E	2	*March* 2	*April* 20	*June* 8
1702	12	12	D	3	*February* 15	5	*May* 24
1703	13	23	C	4	7	*March* 28	16
1704	14	4	B A	5	26	*April* 16	*June* 4
1705	15	15	G	6	18	8	*May* 27
1706	16	26	F	7	3	*March* 24	12
1707	17	7	E	8	23	*April* 13	*June* 1
1708	18	18	D C	9	14	4	*May* 23
1709	19	29	B	10	*March* 6	24	12
1710	1	11	A	11	*February* 19	9	*May* 28
1711	2	22	G	12	11	1	20
1712	3	3	F E	13	4	14	*June* 2
1713	4	14	D	14	16	6	*May* 25
1714	5	25	C	15	8	*March* 29	17
1715	6	6	B	16	7	*April* 11	30
1716	7	15	A	17	13	3	*May* 22

January hath XXXI Days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	First Year. 1693. 1697.		Second Year. 1694. 1698.		Third Year. 1695. 1699.		Leap-Year. 1696. 1700.	
			☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.
			D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
			♑.	South.	♑.	South.	♑.	South.	♑.	South.
1	A	Circumciſ.	22 02	21 41	21 47	21 44	21 32	21 46	21 17	21 48
2	B	Sun riſe 8.	23 03	21 31	22 48	21 34	22 33	21 36	22 19	21 38
3	C		24 04	21 21	23 49	21 23	23 35	21 26	23 20	21 28
4	D		25 05	21 10	24 51	21 13	24 36	21 15	24 21	21 18
5	E		26 07	20 59	25 52	21 01	25 37	21 04	25 22	21 07
6	F	Epiphany.	27 08	20 47	26 53	20 50	26 38	20 53	26 23	20 55
7	G		28 09	20 35	27 54	20 38	27 39	20 41	27 24	20 44
8	A		29 10	20 23	28 55	20 26	28 40	20 29	28 25	20 32
9	B	*Sol* in *Aquar.*	♒. 11	20 10	29 56	20 13	29 41	20 16	29 26	20 19
10	C		01 12	19 56	♒. 57	20 00	♒. 42	20 03	♒. 27	20 06
11	D		02 13	19 43	01 58	19 46	01 43	19 50	01 29	19 53
12	E		03 14	19 29	02 59	19 32	02 44	19 36	02 30	19 39
13	F	Sun r. 7. 45	04 15	19 15	04 00	19 18	03 45	19 22	03 31	19 25
14	G		05 16	19 00	05 01	19 04	04 46	19 07	04 32	19 11
15	A		06 17	18 45	06 02	18 49	05 47	18 52	05 33	18 56
16	B		07 18	18 30	07 03	18 33	06 48	18 37	06 34	18 41
17	C		08 19	18 14	08 04	18 18	07 49	18 22	07 35	18 25
18	D		09 20	17 58	09 05	18 02	08 50	18 06	08 35	18 10
19	E		10 21	17 42	10 06	17 46	09 51	17 50	09 36	17 54
20	F		11 22	17 25	11 07	17 29	10 52	17 33	10 37	17 37
21	G		12 23	17 08	12 08	17 12	11 53	17 16	11 38	17 20
22	A	Sun r. 7. 30	13 23	16 51	13 08	16 55	12 54	16 59	12 39	17 03
23	B		14 24	16 33	14 09	16 38	13 55	16 42	13 40	16 46
24	C	*Hydra's* heart	15 24	16 15	15 10	16 20	14 55	16 24	14 41	16 30
25	D	Co. S. *Paul*	16 25	15 57	16 11	16 02	15 56	16 06	15 41	16 11
26	E		17 26	15 39	17 12	15 43	16 57	15 48	16 42	15 52
27	F		18 27	15 20	18 12	15 25	17 58	15 29	17 43	15 34
28	G		19 28	15 01	19 13	15 06	18 58	15 11	18 44	15 15
29	A		20 28	14 42	20 14	14 47	19 59	14 52	19 44	14 56
30	B	K. *Char.* B.	21 29	14 23	21 14	14 28	21 00	14 32	20 45	14 37
31	C	Sun r. 7. 14	22 30	14 03	22 15	14 08	22 00	14 13	21 46	14 18

February hath XXVIII days.

Month days.	Week days.	Remarkable days, & fouthing of ſtars at midnight.	First Year.		Second Year.		Third Year.		Leap Year.	
			1693.	1697.	1694.	1698.	1695.	1699.	1696.	1700.
			☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.
			D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
			♒.	South.	♒.	South.	♒.	South.	♒.	South.
1	D		23 30	13 43	23 16	13 48	23 01	13 53	22 46	13 58
2	E	Purif *Mary*	24 31	13 23	24 16	13 28	24 01	13 33	23 47	13 38
3	F	Lions Heart.	25 31	13 03	25 17	13 08	25 02	13 13	24 47	13 18
4	G		26 32	12 43	26 17	12 48	26 02	12 53	25 48	12 58
5	A		27 32	12 22	27 18	12 27	27 03	12 32	26 48	12 37
6	B	Lions Neck.	28 33	12 01	28 18	12 06	28 03	12 10	27 49	12 16
7	C	Sun r. 7. 1.	29 33	11 40	29 19	11 45	29 04	11 50	28 49	11 55
8	D	*Sol* in *Piſces.*	♓. 34	11 18	♓. 19	11 24	♓. 04	11 29	29 50	11 34
9	E		01 34	10 57	01 19	11 02	01 05	11 08	♓. 50	11 13
10	F		02 34	10 35	02 20	10 41	02 05	10 46	01 50	10 51
11	G		03 35	10 14	03 20	10 19	03 05	10 24	02 51	10 30
12	A		04 35	09 52	04 20	09 57	04 06	10 02	03 51	10 08
13	B		05 35	09 30	05 20	09 35	05 06	09 40	04 51	09 46
14	C	*Valentine.*	06 35	09 07	06 21	09 13	06 06	09 18	05 51	09 24
15	D	Sun r. 6. 46	07 35	08 45	07 21	08 51	07 06	08 56	06 52	09 01
16	E	Lower of two fore-	08 36	08 23	08 21	08 28	08 06	08 34	07 52	08 39
17	F	moſt in □ of	09 36	08 00	09 21	08 05	09 07	08 11	08 52	08 16
18	G	great Bear.	10 36	07 37	10 21	07 43	10 07	07 48	09 52	07 54
19	A		11 36	07 14	11 21	07 20	11 07	07 26	10 52	07 31
20	B		12 36	06 51	12 21	06 57	12 07	07 03	11 52	07 08
21	C		13 36	06 28	13 21	06 34	13 07	06 40	12 52	06 45
22	D		14 36	06 05	14 21	06 11	14 07	06 17	13 52	06 22
23	E	Sun r. 6. 30	15 36	05 42	15 21	05 48	15 07	05 53	14 52	05 59
24	F		16 36	05 19	16 21	05 25	16 07	05 30	15 52	05 36
25	G	S. *Matthias*	17 35	04 56	17 21	05 01	17 06	05 07	16 52	05 13
26	A		18 35	04 32	18 21	04 38	18 06	04 43	17 52	04 49
27	B		19 35	04 09	19 21	04 14	19 06	04 20	18 52	04 26
28	C		20 35	03 45	20 20	03 51	20 06	03 57	19 51	04 02
29	D		When it is Leap-Year, *February* hath 29 days.						20 51	03 39

March hath XXXI Days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	First Year. 1693. 1697.				Second Year. 1694. 1698.				Third Year. 1695. 1699.				Leap-Year. 1696. 1700.			
			⊙ pla.		⊙ dec.		⊙ pla.		⊙ dec.		⊙ pla.		⊙ dec.		⊙ pla.		⊙ dec.	
			D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
			♓.		South.		♓.		South.		♓.		South.		♓.		South.	
1	D	*David.*	21	34	03	22	21	20	03	27	21	06	03	33	21	51	03	15
2	E	Lion's Tail.	22	34	02	58	22	20	03	04	22	05	03	09	22	50	02	51
3	F	lower of the	23	34	02	34	23	19	02	40	23	05	02	46	23	50	02	28
4	G	two latter in □ of great	24	33	02	11	24	19	02	16	24	05	02	22	24	50	02	04
5	A	Bear.	25	33	01	47	25	19	01	53	25	04	01	58	25	49	01	41
6	B		26	33	01	23	26	18	01	29	26	04	01	35	26	49	01	17
7	C		27	32	01	00	27	18	01	05	27	03	01	11	27	48	00	53
8	D	Sun r. 6.4.	28	32	00	36	28	17	00	42	28	03	00	47	28	48	00	29
9	E	Upper of 2	29	31	00	12	29	17	00	18	29	02	00	24	29	47	00	06
10	F	latter in □	♈.	30	*Nor*	12	♈.	16	*Nor.*	6	♈.	02	00	00	♈.	47	*Nor*	18
11	G	of Gr. Bear.	01	30	00	35	01	15	00	29	01	01	*Nor*	24	01	46	00	42
12	A	*Sol* in *Aries.*	02	29	00	59	02	15	00	53	02	00	00	47	02	45	01	05
13	B		03	28	01	22	03	14	01	17	03	00	01	11	03	45	01	29
14	C		04	28	01	46	04	13	01	40	03	59	01	35	04	44	01	52
15	D		05	27	02	10	05	12	02	04	04	58	01	58	05	43	02	16
16	E		06	26	02	33	06	12	02	27	05	57	02	22	06	42	02	39
17	F		07	25	02	56	07	11	02	51	06	56	02	45	07	41	03	03
18	G	Sun r. 5.44	08	24	03	20	08	10	03	14	07	56	03	09	08	40	03	26
19	A		09	23	03	43	09	09	03	38	08	55	03	32	09	39	03	49
20	B		10	22	04	06	10	08	04	01	09	54	03	55	10	38	04	13
21	C	Laſt but two	11	21	04	30	11	07	04	24	10	53	04	18	11	37	04	36
22	D	in gr. Bear's Tail.	12	20	04	53	12	06	04	47	11	52	04	42	12	36	04	59
23	E		13	19	05	16	13	05	05	10	12	51	05	05	13	35	05	22
24	F		14	18	05	39	14	04	05	33	13	50	05	28	14	34	05	45
25	G	An. *Mary.*	15	17	06	01	15	03	05	56	14	49	05	50	15	33	06	08
26	A	Sun r. 5.28	16	16	06	24	16	02	06	19	15	47	06	13	16	32	06	30
27	B		17	15	06	47	17	00	06	41	16	46	06	36	17	31	06	53
28	C		18	14	07	09	17	59	07	04	17	45	06	58	18	30	07	15
29	D	Virg. Spike. Laſt but one	19	12	07	32	18	58	07	26	18	44	07	21	19	28	07	38
30	E	in gr. Bear's	20	11	07	54	19	57	07	49	19	43	07	43	20	27	08	00
31	F	Tail.	21	10	08	16	20	55	08	11	20	41	08	05	21	26	08	22

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	Firſt Year.				Second Year.				Third Year.				Leap Year.			
			1693.		1697.		1694.		1698.		1695.		1699.		1696.		1700.	
			☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.	
			D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
			♈.		North.		♈.		North.		♈.		North.		♈.		North.	
1	G	Sun r.5.15	22	08	08	38	21	54	08	33	21	40	08	27	22	24	08	44
2	A		23	07	09	00	22	53	08	55	22	38	08	49	23	23	09	06
3	B		24	05	99	22	23	51	09	16	23	37	09	11	24	21	09	27
4	C	Laſt in great Bear's Tail.	25	04	09	43	24	50	09	38	24	36	09	33	25	20	09	49
5	D		26	02	10	04	25	48	09	59	25	34	09	54	26	18	10	10
6	E		27	01	10	26	26	47	10	21	26	33	10	15	27	17	10	31
7	F		27	59	10	47	27	45	10	42	27	31	10	37	28	15	10	52
8	G		28	58	11	08	28	44	11	03	28	29	10	57	29	14	11	13
9	A	Sun r. 5.1.	29	56	11	28	29	42	11	23	29	28	11	18	♉.	12	11	34
10	B	*Sol* in *Taurus.*	♉.	55	11	49	♉.	40	11	44	♉.	26	11	39	01	10	11	54
11	C	Dragon's tail	01	53	12	09	01	39	12	95	01	25	11	59	02	09	12	15
12	D	Arcturus.	02	51	12	29	02	37	12	24	02	23	12	19	03	07	12	35
13	E		03	49	12	49	03	35	12	44	03	21	12	39	04	05	12	54
14	F		04	48	13	09	04	33	13	04	04	19	12	59	05	03	13	14
15	G		05	46	13	28	05	32	13	24	05	18	13	19	06	02	13	34
16	A		06	44	13	47	06	30	13	43	06	16	13	38	07	00	13	53
17	B		07	42	14	07	07	28	14	02	07	14	13	57	07	58	14	12
18	C		08	40	14	25	08	26	14	21	08	12	14	16	08	56	14	30
19	D	Sun r.4.45	09	38	14	44	09	24	14	39	09	10	14	35	09	54	14	49
20	E	ſouthermoſt Scale of Lib.	10	36	15	02	10	22	14	58	10	08	14	53	10	52	15	07
21	F		11	34	15	20	11	20	15	16	11	06	15	12	11	50	15	25
22	G		12	32	15	38	12	18	15	34	12	04	15	30	12	48	15	43
23	A		13	30	16	56	13	16	15	52	13	02	15	47	13	46	16	00
24	B		14	28	16	13	14	14	16	09	14	00	16	05	14	44	16	18
25	C	*Mark* Ev.	15	26	16	30	15	12	16	26	14	58	16	22	15	42	16	35
26	D	Upper of the two formoſt in □ of the little Bear.	16	24	16	47	16	10	16	43	15	56	16	39	16	40	16	51
27	E		17	22	17	03	17	08	16	59	16	54	16	55	17	38	17	08
28	F		18	20	17	20	18	06	17	16	17	52	17	12	18	36	17	24
29	G	northermoſt Scale of Lib.	19	18	17	36	19	04	17	32	18	50	17	28	19	33	17	40
30	A	Sun r.4.24	20	15	17	51	20	01	17	47	19	47	17	44	20	31	17	55

May hath XXXI Days.

Month days.	Week days.	Remarkable days, & fouthing of ſtars at midnight.	First Year.				Second Year.				Third Year.				Leap Year.			
			1693.		1697.		1694.		1698.		1695.		1699.		1696.		1700.	
			☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.	
			D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
			♉.		North.		♉.		North.		♉.		North.		♉.		North.	
1	B	*Phil.& Ja.*	21	13	18	07	20	59	18	03	20	45	17	59	21	29	18	11
2	C		22	11	18	22	21	57	18	18	21	43	18	14	22	27	18	26
3	D	Brighteſt in the Crown.	23	09	18	36	22	55	18	33	22	41	18	29	23	24	18	40
4	E	Brighteſt in Serp. Neck.	24	06	18	51	23	52	18	47	23	38	18	44	24	22	18	55
5	F		25	04	19	05	24	50	19	01	24	36	18	58	25	20	19	09
6	G	Sun r.4. 15	26	02	19	19	25	48	19	15	25	34	19	12	26	17	19	22
7	A		26	59	19	32	26	45	19	29	26	31	19	26	27	15	19	36
8	B		27	57	19	45	27	43	19	42	27	29	19	39	28	13	19	49
9	C	Scorpion's Forehead.	28	54	19	58	28	40	19	55	28	26	19	52	29	10	20	02
10	D		29	52	20	11	29	38	20	08	29	24	20	05	♊.	08	20	14
11	E	*Sol* in *Gem.*	♊.	49	20	23	♊.	36	20	20	♊.	22	20	17	01	05	20	26
12	F		01	47	20	34	01	33	20	32	01	19	20	29	02	03	20	38
13	G		02	44	20	46	02	31	20	43	02	17	20	40	03	00	20	49
14	A	Scorpion's Heart.	03	42	20	57	03	28	20	54	03	14	20	52	03	58	21	00
15	B		04	39	21	08	04	26	21	05	04	12	21	03	04	55	21	11
16	C		05	37	21	18	05	23	21	16	05	09	21	13	05	53	21	21
17	D	Sun r. 4.	06	34	21	28	06	20	21	26	06	07	21	23	06	50	21	31
18	E		07	32	21	38	07	18	21	35	07	04	21	33	07	47	21	40
19	F		08	29	21	47	08	15	21	45	08	01	21	42	08	45	21	49
20	G		09	27	21	56	09	13	21	54	08	59	21	51	09	42	21	58
21	A		10	24	22	04	10	10	22	02	09	56	22	00	10	40	22	07
22	B		11	21	22	12	11	07	22	10	10	53	22	08	11	37	22	14
23	C		12	19	22	20	12	05	22	18	11	51	22	16	12	34	22	22
24	D		13	16	22	27	13	02	22	26	12	48	22	24	13	32	22	29
25	E		14	13	22	34	13	59	22	33	13	45	22	31	14	29	22	36
26	F		15	11	22	41	14	57	22	39	14	43	22	38	15	26	22	43
27	G		16	08	22	47	15	54	22	46	15	40	22	44	16	24	22	49
28	A		17	05	22	53	16	51	22	52	16	37	22	50	17	21	22	54
29	B	K. *Charles* 2d Nat. and Ret.	18	02	22	58	17	48	22	57	17	35	22	56	18	18	22	59
30	C		19	00	23	03	18	46	23	02	18	32	23	01	19	15	23	04
31	D	Sun r.3. 51	19	56	23	08	19	43	23	07	19	29	23	06	20	13	23	09

June hath XXX days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	First Year. 1693.		1697.		Second Year. 1694.		1698.		Third Year. 1695.		1699.		Leap Year. 1696.		1700.	
			☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.	
			D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
			♊.		North.		♊.		North.		♊.		North.		♊.		North.	
1	E		20	54	23	11	20	40	23	10	20	26	23	09	21	10	23	12
2	F		21	51	23	15	21	37	23	14	21	24	23	13	22	07	23	16
3	G	Fight with *Dutch* 1652. 1665.	22	49	23	18	22	35	23	17	22	21	23	16	23	04	23	19
4	A		23	46	23	21	23	32	23	20	23	18	23	20	24	01	23	22
5	B		24	43	23	23	24	29	23	23	24	15	23	22	24	59	23	24
6	C		25	40	23	26	25	26	23	25	25	12	23	25	25	56	23	26
7	D		26	37	23	27	26	23	23	27	26	10	23	27	26	53	23	28
8	E		27	34	23	29	27	21	23	28	27	07	23	28	27	50	23	29
9	F		28	32	23	29	28	18	23	29	28	04	23	29	28	47	23	30
10	G	Sun r.3.48	29	29	23	30	29	15	23	30	29	01	23	30	29	45	23	30
11	A	*Sol* in *Cancer*	♋.	26	23	30	♋.	12	23	30	29	58	23	30	♋.	42	23	30
12	B		01	23	23	30	01	09	23	30	♋.	56	23	30	01	39	23	29
13	C		02	20	23	29	02	06	23	29	01	53	23	29	02	36	23	28
14	D		03	18	23	28	03	04	23	28	02	50	23	28	03	33	23	27
15	E		04	15	23	26	04	01	23	26	03	47	23	27	04	30	23	25
16	F		05	12	23	24	04	58	23	25	04	44	23	25	05	27	23	23
17	G	Brighteſt in the Harp.	06	09	23	22	05	55	23	22	05	41	23	23	06	25	23	21
18	A		07	06	23	19	06	52	23	19	06	38	23	20	07	22	23	18
19	B		08	03	23	16	07	49	23	16	07	36	23	17	08	19	23	15
20	C		09	00	23	12	08	47	23	13	08	33	23	14	09	16	23	11
21	D	Sun r.3.50	09	58	23	08	09	44	23	09	09	30	23	10	10	13	23	07
22	E		10	55	23	03	10	41	23	04	10	27	23	06	11	10	23	02
23	F		11	52	22	58	11	38	23	00	11	24	23	01	12	08	22	57
24	G	*John Bapt.*	12	49	22	53	12	35	22	54	12	21	22	56	13	05	22	52
25	A		13	46	22	48	13	32	22	49	13	19	22	50	14	02	22	46
26	B		14	43	22	41	14	30	22	43	14	16	22	44	14	59	22	40
27	C		15	41	22	35	15	27	22	37	15	13	22	38	15	56	22	33
28	D		16	38	22	28	16	24	22	30	16	10	22	32	16	53	22	26
29	E	*Peter* Ap.	17	35	22	21	17	21	22	23	17	07	22	25	17	51	22	19
30	F		18	32	22	13	18	18	22	15	18	04	22	17	18	48	22	11

July hath XXXI Days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	Firſt Year.		Second Year.		Third Year.		Leap-Year.	
			1693.	1697.	1694.	1698.	1695.	1699.	1696.	1700.
			⊙ pla.	⊙ dec.	⊙ pla.	⊙ dec.	⊙ pla.	⊙ dec.	⊙ pla.	⊙ dec.
			D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
			♋.	North.	♋.	North.	♋.	North.	♋.	North.
01	G	Sun r.3.57	19 29	22 04	19 15	22 26	19 62	22 08	19 45	22 02
02	A		20 26	21 56	20 13	21 58	19 59	22 00	20 42	21 54
03	B		21 24	21 47	21 10	21 49	20 56	21 52	21 39	21 45
04	C	Brighteſt between the Eagle's Shoulders.	22 21	21 38	22 07	21 40	21 53	21 43	22 37	21 36
05	D		23 18	21 29	23 04	21 31	22 50	21 33	23 34	21 26
06	E		24 15	21 19	24 02	21 21	23 48	21 24	24 31	21 16
07	F		25 13	21 09	24 59	21 11	24 45	21 14	25 28	21 06
08	G		26 10	20 58	25 56	21 01	25 42	21 03	26 26	20 55
09	A		27 07	20 47	26 53	20 50	26 39	20 52	27 23	20 44
10	B		28 04	20 36	27 51	20 39	27 37	20 41	28 20	20 33
11	C		29 02	20 24	28 48	20 27	28 34	20 30	29 17	20 21
12	D		29 59	20 12	29 45	20 15	29 31	20 18	♌. 15	20 09
13	E	*Sol* in *Leo.*	♌ 59	20 00	♌ 42	20 03	♌. 29	20 06	01 12	19 56
14	F		01 54	19 47	01 40	19 50	01 26	19 53	02 09	19 44
15	G		02 51	19 34	02 37	19 37	02 23	19 41	03 07	19 31
16	A		03 48	19 21	03 34	19 24	03 21	19 27	04 04	19 17
17	B	Sun r.4.15	04 46	19 07	04 32	19 11	04 18	19 14	05 01	19 03
18	C	Swan's Tail.	05 43	18 53	05 29	18 57	05 15	19 00	05 59	18 49
19	D	Dog-days begin.	06 40	18 39	06 27	18 43	06 13	18 46	06 56	18 35
20	E		07 38	18 24	07 24	18 28	07 10	18 32	07 54	18 20
21	F		08 35	18 10	08 21	18 13	08 08	18 17	08 51	18 06
22	G		09 33	17 55	09 19	17 58	09 05	18 02	09 48	17 50
23	A		10 30	17 39	10 16	17 43	10 02	17 47	10 46	17 35
24	B		11 28	17 23	11 14	17 27	11 00	17 31	11 43	17 19
25	C	*James Ap.*	12 25	17 07	12 11	17 11	11 57	17 15	12 41	17 03
26	D	Sun r.4.30	13 24	16 51	13 09	16 54	12 55	16 59	13 38	16 46
27	E		14 20	16 34	14 06	16 38	13 52	16 42	14 36	16 30
28	F		15 18	16 18	15 04	16 22	14 50	16 26	15 34	16 13
29	G		16 15	16 00	16 01	16 05	15 48	16 09	16 31	15 56
30	A		17 13	15 43	16 59	15 47	16 45	15 52	17 29	15 38
31	B		18 11	15 26	17 57	15 30	17 43	15 34	18 26	15 21

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at Midnight.	First Year. 1693. 1697. ☉ pla. D. M.	First Year. 1693. 1697. ☉ dec. D. M.	Second Year. 1694. 1698. ☉ pla. D. M.	Second Year. 1694. 1698. ☉ dec. D. M.	Third Year. 1695. 1699. ☉ pla. D. M.	Third Year. 1695. 1699. ☉ dec. D. M.	Leap Year. 1696. 1700. ☉ pla. D. M.	Leap Year. 1696. 1700. ☉ dec. D. M.
			♌.	North.	♌.	North.	♌.	North.	♌.	North.
1	C		19 08	15 08	18 54	15 12	18 40	15 16	19 24	15 03
2	D	Pegaſus	20 06	14 49	19 52	14 54	19 38	14 58	20 22	14 44
3	E	Mouth.	21 04	14 31	20 50	14 36	20 36	14 40	21 19	14 26
4	F	Sun r.4.45.	22 01	14 12	21 47	14 17	21 33	14 22	22 17	14 07
5	G		22 59	13 54	22 45	13 58	22 31	14 03	23 15	13 48
6	A		23 57	13 35	23 43	13 39	23 29	13 44	24 13	13 29
7	B		24 55	13 15	24 41	13 20	24 27	13 25	25 10	13 10
8	C		25 52	12 56	25 38	13 01	25 24	13 05	26 08	12 51
9	D		26 50	12 36	26 36	12 41	26 22	12 46	27 06	12 31
10	E		27 48	12 16	27 34	12 21	27 20	12 26	28 04	12 11
11	F		28 46	11 56	28 32	12 01	28 18	12 06	29 02	11 51
12	G		29 44	11 36	29 30	11 41	29 16	11 46	30 00	11 30
13	A	*Sol* in *Virgo.*	♍. 42	11 16	♍. 28	11 21	♍. 14	11 26	♍. 58	11 10
14	B		01 40	10 55	01 26	11 00	01 12	11 05	01 56	10 49
15	C	Sun r. 5.2.	02 38	10 34	02 24	10 39	02 10	10 44	02 54	10 28
16	D		03 36	10 13	03 22	10 18	03 08	10 23	03 52	10 07
17	E		04 34	09 52	04 30	09 57	04 06	10 02	04 50	09 46
18	F		05 32	09 31	05 18	09 36	05 04	09 14	05 48	09 25
19	G		06 30	09 09	06 16	09 15	06 02	09 20	06 46	09 03
20	A		07 28	08 48	07 14	08 53	07 00	08 58	07 44	08 42
21	B	Formahant.	08 27	08 26	08 12	08 31	07 58	08 37	08 42	08 20
22	C		09 25	08 40	09 11	08 09	08 57	08 15	09 41	07 58
23	D		10 23	07 42	10 09	07 47	09 55	07 53	10 39	07 36
24	E	*Barthol.* Ap	11 21	07 20	11 07	07 25	10 53	07 31	11 37	07 14
25	F	Firſt in Pe-	12 19	06 58	12 05	07 03	11 51	07 09	12 35	06 52
26	G	gaſus. Wing,	13 18	06 35	13 04	06 41	12 50	06 46	13 34	06 29
27	A	and begin. of his Leg.	14 16	06 13	14 02	06 18	13 48	06 24	14 32	06 07
28	B	Dog-da. end.	15 15	05 50	15 00	05 56	14 46	06 01	15 30	05 44
29	C	Sun r.5.32.	16 13	05 28	15 59	05 33	15 45	05 39	16 29	05 22
30	D		17 11	05 05	16 57	05 10	16 43	05 16	17 27	04 59
31	E		18 10	04 42	17 56	04 48	17 42	04 53	18 26	04 26

September hath XXX Days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	First Year. 1693. 1697.				Second Year. 1694. 1698.				Third Year. 1695. 1699				Leap Year. 1696. 1700.			
			☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla		☉ dec.		☉ pla.		☉ dec.	
			D.	M.	D.	M.	D.	M.	D.	M.	D.	M	D.	M.	D.	M.	D.	M.
			♍.		North.		♍.		North.		♍.		North.		♍.		North.	
1	F	Sun r.5.37	19	08	04	19	18	54	04	25	18	40	04	30	19	24	04	13
2	G	*Lon.*burnt 66	20	07	03	56	19	53	04	02	19	39	04	07	20	23	03	50
3	A	*O.Crom.* died	21	06	03	33	20	51	03	39	20	37	03	44	21	22	03	27
4	B	1658.	22	04	03	10	21	50	03	15	21	36	03	21	22	20	03	03
5	C		23	03	02	47	22	49	02	52	22	34	02	58	23	19	02	40
6	D		24	01	02	23	23	47	02	29	23	33	02	35	24	17	02	17
7	E		25	00	02	00	24	46	02	06	24	32	02	11	25	16	01	54
8	F		25	59	01	37	25	45	01	42	25	30	01	48	26	15	01	30
9	G		26	58	01	13	26	43	01	19	26	29	01	25	27	14	01	07
10	A	*Andromeda*'s	27	57	00	50	27	42	00	56	27	28	01	01	28	13	00	43
11	B	Head.	28	55	00	26	28	41	00	32	28	27	00	38	29	11	00	20
12	C	End of *Pegaſus*'s Wing.	29	54	00	03	29	40	00	09	29	26	00	14	♎.	10	*Sou.*	31
13	D	*Sol* in *Libra.*	♎.	53	*Sou.*	21	♎.	39	*Sou.*	15	♎.	25	*Sou.*	09	01	09	00	27
14	E	Sun r. 6.2.	01	52	00	44	01	38	00	38	01	24	00	33	02	08	00	51
15	F		02	51	01	08	02	37	01	02	02	23	00	56	03	07	01	14
16	G		03	50	01	31	03	36	01	25	03	22	01	20	04	06	01	38
17	A		04	49	01	55	04	35	01	49	04	21	01	43	05	05	02	01
18	B		05	48	02	18	05	34	02	12	05	20	02	07	06	04	02	25
19	C		06	47	02	42	06	33	02	36	06	19	02	30	07	04	02	48
20	D		07	47	03	05	07	32	02	59	07	18	02	54	08	03	03	11
21	E	*Matth.*Ev.	08	46	03	28	08	31	03	23	08	17	03	17	09	02	03	35
22	F	Pole Star.	09	45	03	52	09	31	03	46	09	16	03	40	10	01	03	58
23	G		10	44	04	15	10	30	04	09	10	16	04	04	11	00	04	21
24	A		11	44	04	38	11	29	04	33	11	15	04	27	12	00	04	45
25	B	Sun r.6.24	12	43	05	02	12	29	04	56	12	14	04	50	12	59	05	08
26	C	Southermoſt	13	42	05	25	13	28	05	19	13	14	05	14	13	59	05	31
27	D	in *Andromeda*'s Girdle.	14	42	05	48	14	27	05	42	14	13	05	37	14	58	05	54
28	E		15	41	06	11	15	27	06	05	15	12	06	00	15	57	06	17
29	F	*Mic.* Arch.	16	41	06	34	16	26	06	28	16	12	06	23	16	57	06	40
30	G		17	40	06	57	17	26	06	51	17	11	06	46	17	56	07	03

October hath XXXI Days.

Month days.	Week days.	Remarkable days, & fouthing of ſtars at midnight.	First Year. 1693. 1697.		Second Year. 1694. 1698.		Third Year. 1695. 1699.		Leap-Year. 1696. 1700.	
			☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.
			D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
			♎.	South.	♎.	South.	♎.	South.	♎.	South.
01	A		18 40	07 19	18 25	07 14	18 11	07 08	18 56	07 26
02	B		19 39	07 42	19 25	07 36	19 10	07 31	19 56	07 48
03	C		20 39	08 04	20 25	07 59	20 10	07 54	20 55	08 11
04	D		21 39	08 27	21 24	08 22	21 10	08 16	21 55	08 33
05	E	Sun r.6.44	22 38	08 49	22 24	08 44	22 09	08 38	22 55	08 55
06	F		23 38	09 11	23 24	09 06	23 09	09 01	23 54	09 17
07	G		24 38	09 33	24 23	09 28	24 09	09 23	24 54	09 39
08	A		25 38	09 55	25 23	09 50	25 09	09 45	25 54	10 01
09	B		26 37	10 17	26 23	10 12	26 08	10 07	26 54	10 23
10	C		27 37	10 39	27 23	10 34	27 08	10 28	27 54	10 45
11	D	*Andromeda*'s	28 37	11 00	28 23	10 55	28 08	10 50	28 54	11 06
12	E	ſouthermoſt Foot.	29 37	11 22	29 23	11 16	29 08	11 11	29 53	11 27
13	F	*Sol* in *Scorp.*	♏. 37	11 43	♏. 23	11 38	♏. 08	11 32	♏. 53	11 48
14	G	Sun r.7. 1.	01 37	12 04	01 23	11 59	01 08	11 53	01 53	12 09
15	A		02 37	12 24	02 23	12 19	02 08	12 14	02 53	12 30
16	B		03 37	12 45	03 23	12 40	03 08	12 35	03 54	12 50
17	C		04 37	13 05	04 23	13 00	04 08	12 55	04 54	13 11
18	D	*Luke* Ev.	05 37	13 25	05 23	13 21	05 08	13 16	05 54	13 31
19	E		06 38	13 45	06 23	13 41	06 08	13 36	06 54	13 51
20	F		07 38	14 05	07 23	14 00	07 09	13 56	07 54	14 10
21	G		08 38	14 25	08 23	14 20	08 09	14 15	08 54	14 30
22	A		09 38	14 44	09 24	14 39	09 09	14 34	09 55	14 49
23	B		10 39	15 03	10 24	14 58	10 09	14 54	10 55	15 08
24	C		11 39	15 22	11 24	15 17	11 10	15 13	11 55	15 27
25	D		12 39	15 40	12 25	15 36	12 10	15 31	12 56	15 45
26	E	Whales Jaw.	13 40	15 59	13 25	15 54	13 10	15 50	13 56	16 03
27	F		14 40	16 17	14 25	16 12	14 11	16 08	14 56	16 21
28	G	*Sim.* & *Jude.*	15 40	16 34	15 26	16 30	15 11	16 25	15 57	16 39
29	A	*Perſeus*	16 41	16 52	16 26	16 48	16 12	16 43	16 57	16 56
30	B	right Side.	17 41	17 09	17 27	17 05	17 12	17 01	17 58	17 13
31	C	Sun r.7.32	18 42	17 26	18 27	17 22	18 13	17 18	18 58	17 30

November hath XXX Days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	First Year.				Second Year.				Third Year.				Leap Year.			
			1693.		1697.		1694.		1698.		1695.		1699		1696.		1700.	
			☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.		☉ pla.		☉ dec.	
			D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
			♏.		South.		♏.		South.		♏.		South.		♏.		South.	
1	D	All Saints.	19	42	17	43	19	28	17	38	19	13	17	34	19	59	17	47
2	E		20	43	17	59	20	28	17	55	20	14	17	51	21	00	18	03
3	F		21	44	18	15	21	29	18	11	21	14	18	07	22	00	18	19
4	G		22	44	18	30	22	30	18	26	22	15	18	23	23	01	18	34
5	A	Pow. Plot.	23	45	18	45	23	30	18	42	23	15	18	38	24	01	18	50
6	B		24	46	19	00	24	31	18	57	24	16	18	53	25	02	19	04
7	C		25	46	19	15	25	32	19	12	25	17	19	08	26	03	19	19
8	D	Sun r. 7.44	26	47	19	29	26	32	19	26	26	18	19	22	27	04	19	33
9	E		27	48	19	43	27	33	19	40	27	18	19	37	28	04	19	47
10	F		28	49	19	57	28	34	19	54	28	19	19	50	29	05	20	00
11	G		29	49	20	10	29	35	20	07	29	20	20	04	♐.	06	20	14
12	A	*Sol* in *Sagit.*	♐.	50	20	23	♐.	35	20	20	♐.	20	20	17	01	07	20	26
13	B		01	51	20	35	01	36	20	32	01	21	20	29	02	08	20	39
14	C		02	52	20	47	02	37	20	44	02	22	20	41	03	08	20	51
15	D		03	53	20	59	03	38	20	56	03	23	20	58	04	09	21	02
16	E		04	54	21	10	04	39	21	08	04	24	21	05	05	10	21	13
17	F	Bull's Eye, or	05	55	21	21	05	40	21	19	05	25	21	16	06	11	21	24
18	G	*Aldebaran.*	06	56	21	32	06	41	21	29	06	26	21	27	07	12	21	34
19	A		07	57	21	42	07	42	21	39	07	27	21	37	08	13	21	44
20	B	Sun riſe 8.	08	58	21	51	08	43	21	49	08	28	21	47	09	14	21	54
21	C	*Wapping*	09	59	22	01	09	44	21	58	09	29	21	56	10	15	22	03
22	D	burnt 1682.	11	00	22	09	10	45	22	07	10	30	22	05	11	16	22	12
23	E		12	01	22	18	11	46	22	16	11	31	22	14	12	17	22	20
24	F		13	02	22	26	12	47	22	24	12	32	22	22	13	18	22	28
25	G	*Capella*, or	14	03	22	33	13	48	22	31	13	33	22	30	14	19	22	35
26	A	Goat.	15	04	22	40	14	49	22	39	14	34	22	37	15	20	22	42
27	B	*Orion*'s Left	16	05	22	47	15	50	22	45	15	35	22	44	16	22	22	49
28	C	Foot. End of Bulls	17	06	22	53	16	51	22	52	16	36	22	50	17	23	22	55
29	D	Horn.	18	07	22	59	17	52	22	57	17	37	22	56	18	24	22	00
30	E	*Andr.* Ap.	19	08	23	04	18	53	23	03	18	39	23	01	19	25	23	05

December hath XXXI Days.

Month days.	Week days.	Remarkable days, & ſouthing of ſtars at midnight.	Firſt Year.		Second Year.		Third Year.		Leap-Year.	
			1693.	1697.	1694.	1698.	1695.	1699.	1696.	1700.
			☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.	☉ pla.	☉ dec.
			D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
			♐.	South.	♐.	South.	♐.	South.	♐.	South.
1	F	Firſt in *Ori-*	20 09	23 08	19 55	23 07	19 40	23 05	20 26	23 09
2	G	*on*'s Belt.	21 11	23 12	20 56	23 11	20 41	23 10	21 27	23 13
3	A	Laſt in *Ori-*	22 12	23 16	21 57	23 15	21 42	23 14	22 28	23 17
4	B	*on*'s Belt.	23 13	23 19	22 58	23 19	22 43	23 18	23 30	23 20
5	C	Sun r. 8. 11.	24 14	23 22	23 59	23 22	23 44	23 21	24 31	23 23
6	D	*Orion*'s right	25 15	23 25	25 00	23 24	24 46	23 24	25 32	23 25
7	E	Shoulder, &	26 17	23 27	26 02	23 26	25 47	23 26	26 33	23 27
8	F	*Auriga*'s right ſhould.	27 18	23 28	27 03	23 28	26 48	23 28	27 34	23 29
9	G		28 19	23 29	28 04	23 29	27 49	23 29	28 36	23 29
10	A		29 20	23 30	29 05	23 30	28 50	23 30	29 37	23 30
11	B	*Sol* in *Capr.*	♑. 21	23 30	♑. 07	23 30	29 52	23 30	♑. 38	23 30
12	C	Sun r. 8. 12	01 23	23 30	01 08	23 30	♑. 53	23 30	01 39	23 29
13	D	Foot of the	02 24	23 29	02 09	23 29	01 54	23 29	02 40	23 28
14	E	great Dog.	03 25	23 28	03 10	23 28	02 55	23 28	03 42	23 27
15	F	Bright Foot	04 26	23 26	04 11	23 26	03 57	23 27	04 43	23 25
16	G	of *Gemini.*	05 28	23 23	05 13	23 24	04 58	23 25	05 44	23 23
17	A	Sun r. 8. 11.	06 29	23 21	06 14	23 21	05 59	23 22	06 45	23 20
18	B	Mouth of the	07 30	23 17	07 15	23 18	07 00	23 19	07 47	23 16
19	C	great Dog,	08 31	23 14	08 16	23 15	08 02	23 16	08 48	23 13
20	D	or *Syrius.*	09 33	23 10	09 18	23 11	09 03	23 12	09 49	23 08
21	E	*Tho.* Apoſt.	10 34	23 05	10 19	23 06	10 04	23 07	10 50	23 04
22	F		11 35	23 00	11 20	23 01	11 05	23 02	11 52	22 58
23	G		12 36	22 54	12 21	22 56	12 07	22 57	12 53	22 53
24	A		13 37	22 48	13 23	22 50	13 08	22 51	13 54	22 47
25	B	Nat. *Chriſt*	14 39	22 42	14 24	22 44	14 09	22 45	14 55	22 40
26	C	St. *Stephen.*	15 40	22 35	15 25	22 37	15 10	22 39	15 57	22 33
27	D	*John* Evan.	16 41	22 28	16 26	22 30	16 11	22 31	16 58	22 16
28	E	*Innocents.*	17 42	22 20	17 27	22 22	17 13	22 24	17 59	22 18
29	F	Caſtor. Little Dog's	18 44	22 13	18 29	22 14	18 14	22 1[illegible]	19 00	22 09
30	G	thigh. Pollux	19 45	22 03	19 30	22 05	19 15	22 07	20 01	22 01
31	A	Sun r. 8. 1.	20 46	21 54	20 31	21 56	20 16	21 59	21 03	21 52

An Explanation of the precedent Kalendar.

IN each Page there are eleven Columns; the firſt ſheweth the Day of the Month; the ſecond, the Days of the Week, expreſſed by the Week-day Letters, as in the Year 1694, in the Month of *April*, you will find F for *Saturday*, and G for *Sunday*, which is the Dominical Letter for that Year, (as you ſee in the Page before the Kalendar.) The third Column ſheweth ſome Remarkable Days, and the Southing of ſeveral Stars at Midnight, with their Declinations from the Equinoctial; as in the aforeſaid Month, you will find againſt the fourth Day, there ſtands the *Laſt in the Great Bear's Tail*, which ſhews, that the ſaid Star comes to the Meridian the fourth day, at twelve of the Clock at Midnight. The fourth Column ſheweth the Place of the Sun for the firſt Year after Leap-Year (according to Mr. *Street*'s Tables); as againſt the third of *April*, you will find the Sun to be in 24° 5′ of *Aries*. The fifth Column ſheweth the Declination of the Sun, for the firſt Year after Leap Year; as againſt the third day aforeſaid, you will find the Sun's Declination to be 9° 22′. And after the ſame manner the other ſix Columns are to be uſed; as againſt the ſaid third day of *April*, you will find in the ſixth Column, in the ſecond Year after Leap-Year, that the Sun's Place is 23° 51′ in *Aries*; and in the ſeventh Column the Sun's Declination to be 9° 16′; and in the eighth Column, and in the third Year after Leap Year, the Sun's Place is 23° 37′ in *Aries*; and in the ninth Column, the Declination of the Sun is 9° 11′; and in the tenth Column, in the Leap-Year the Sun's Place is 24° 21′ in *Aries*; and in the eleventh Column, the Sun's Declination is 9° 27′.

How to find the Day of the Month, or Week-Day, for any Time paſt or to come, by the precedent Kalendar.

FIRST, you muſt find the Dominical Letter by the Table before the Kalendar, or elſe by the Rule delivered in *Chap.* 8. *Sect.* 3. and thereby you may diſcover the Day of the Month, as follows.

Example 1.

What Day of the Month was the firſt Monday in Auguſt, *in the Year* 1645?

By the former Rule you will find the Dominical Letter was E; then turning to the Month of *Auguſt*, call E *Sunday*, and the F that follows is Monday, and the firſt Monday is the 4*th* Day of the Month.

Example 2.

What Day of the Week will the Tenth of February *be in the Year* 1708?

This Year will be Leap-Year, and in the Table hath two Dominical Letters, D and C; the firſt of them ſerving from the Firſt of *January*, till the 25*th* of *February*, and the other from thence to the Year's end: Therefore againſt the 10*th* of *February* ſtands F; then calling D Sunday, E is Monday, and F is Tueſday, the Week-Day ſought.

Example 3.

What Day of the Month is the ſecond Thurſday in the Month of Auguſt, *in the Year* 1708?

The Dominical Letter for the latter part of the Year is C, therefore C ſtands for Sunday, D for Monday, E for Tueſday, F for Wedneſday, G for Thurſday; and againſt the ſecond G in *Auguſt*, is the 12*th* Day of the Month, which was required.

A Table of the Variation of the Sun's Declination, to be applied for Years to come, according to the Title on the Right-hand; but for Years paſt, contrarily.

Years.		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Month	D.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
January,	1	0	1	01	01	01	02	02	02	03	03	03	03	04	04	04	North.
	11	0	1	01	01	02	02	03	03	04	04	04	05	05	05	06	
	21	0	1	01	02	02	03	03	04	04	05	05	06	06	07	07	
February,	1	1	1	02	02	03	03	04	05	05	06	06	07	08	08	09	
	11	1	1	02	03	03	04	05	05	06	06	07	08	08	09	10	
	21	1	1	02	03	03	04	05	05	06	07	08	08	09	10	10	
March,	1	1	1	02	03	04	04	05	06	06	07	08	08	09	10	11	
	11	1	1	02	03	04	04	05	06	06	07	08	09	09	10	11	
	21	1	1	02	03	04	04	05	06	06	07	08	08	09	10	11	
April,	1	1	1	02	03	03	04	05	05	06	07	07	08	09	10	10	
	11	1	1	02	03	03	04	04	05	06	06	07	08	08	09	10	
	21	1	1	02	02	03	03	04	05	05	06	06	07	07	08	08	
May,	1	0	1	01	02	02	03	03	04	04	05	05	06	06	07	07	
	11	0	1	01	02	02	02	03	03	03	04	04	05	05	05	06	
	21	0	1	01	01	01	02	02	02	02	03	03	03	03	04	04	
June,	1	0	0	00	01	01	01	01	01	01	01	01	02	02	02	02	South.
	11	0	0	00	00	00	00	00	00	00	00	00	02	00	00	00	
	21	0	0	00	01	01	01	01	01	01	01	01	02	02	02	02	
July,	1	0	1	01	01	01	02	02	02	02	03	03	03	03	04	04	
	11	0	1	01	02	02	02	03	03	03	04	04	05	05	05	06	
	21	0	1	01	02	02	03	03	04	04	05	05	06	06	07	07	
Auguſt,	1	1	1	02	02	03	03	04	05	05	06	06	07	07	08	09	
	11	1	1	02	03	03	04	04	05	06	06	07	08	08	09	10	
	21	1	1	02	03	03	04	05	05	06	07	08	08	09	10	10	
September,	1	1	1	02	03	04	04	05	06	06	07	08	09	09	10	11	
	11	1	1	02	03	04	04	05	06	06	07	08	09	09	10	11	
	21	1	1	02	03	04	04	05	06	06	07	08	09	09	10	11	
October,	1	1	1	02	03	03	04	05	05	06	07	08	08	09	10	10	
	11	1	1	02	03	03	04	04	05	06	06	07	08	08	09	10	
	21	1	1	02	02	03	03	04	05	05	06	06	07	07	08	09	
November,	1	0	1	01	02	02	03	03	04	04	05	05	06	06	07	07	
	11	0	1	01	02	02	02	03	03	03	04	04	05	05	05	06	
	21	0	1	01	01	01	02	02	02	02	03	03	03	03	04	04	
December,	1	0	0	00	01	01	01	01	01	01	01	02	02	02	02	02	
	11	0	0	00	00	00	00	00	00	00	00	00	00	00	00	00	
	21	0	0	00	01	01	01	01	01	01	01	02	02	02	02	02	

A Table of the Variation of the Sun's Declination in Hours.

Hours from the Meridian of London.

Diurn. Variat.	1	2	3	4	5	6	7	8	9	10	11	12
min.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
2	00	00	00	00	00	00	01	01	01	01	01	01
3	00	00	00	00	01	01	01	01	01	01	01	01
4	00	00	00	01	01	01	01	01	01	02	02	02
5	00	00	01	01	01	01	01	02	02	02	02	02
6	00	00	01	01	01	01	02	02	02	02	03	03
7	00	01	01	01	01	02	02	03	03	03	03	03
8	00	01	01	01	02	02	02	03	03	03	04	04
9	00	01	01	01	02	02	03	03	03	04	04	04
10	00	01	01	02	02	02	03	03	04	04	05	05
11	00	01	01	02	02	03	03	04	04	05	05	05
12	00	01	01	02	02	03	03	04	04	05	05	06
13	01	01	02	02	03	03	04	04	05	05	06	06
14	01	01	02	02	03	03	04	05	05	06	06	07
15	01	01	02	02	03	04	04	05	06	06	07	07
16	01	01	02	03	03	04	05	05	06	07	07	08
17	01	01	02	03	04	04	05	06	06	07	08	08
18	01	01	02	03	04	04	05	06	07	07	08	09
19	01	02	02	03	04	05	06	06	07	08	09	09
20	01	02	02	03	04	05	06	06	07	08	09	10
21	01	02	03	03	04	05	06	07	08	09	10	10
22	01	02	03	04	05	05	06	07	08	09	10	11
23	01	02	03	04	05	06	07	08	09	10	11	11
24	01	02	03	04	05	06	07	08	09	10	11	12

Examples of the Uſe of the foregoing Tables, *For the Sun's Declination for Years to come*, &c.

Example 1.

Anno 1695, *May* 1. the Declination of the Sun is required.

Firſt, From the Year 1695, I deduct all the Hundreds and Scores, that is 1680; and the Reſidue 15 I divide by 4; the laſt Remainder 3, ſhews it is the third after Leap-year. Therefore, Secondly, In the Kalendar for four Years, I look for the third after Leap-Year, and do find it anſwer to 1675; in which Year, on *May* 1. the Declination of the Sun is 17° 59′ North. Thirdly, Then out of 1695, I ſubtract 1675, and with the Reſidue 20, I enter the *Table of the Variation of the Sun's Declination for Years*, &c. where under 20 Years in the Head of the Table, and againſt *May* 1. on the left-hand, I find the Variation 2′ North: But the afore-found Declination was alſo North, therefore to the ſaid Declination 17° 59′, I add the Variation 2′, and the Sum is 18° 1′ North, the true Declination of the Sun, *Anno* 1695, *May* 1. in the Meridian of *London* as was required.

Example 2.

Anno 1728, *Septemb.* 1. I would know the Sun's Declination; from 1728, rejecting the Hundreds and Scores, I divide the Reſidue, which is 8, by 4, the Remainder 0 ſhews it is a Leap-Year; under which Title, I find 1676; in which Year, on the firſt Day of *September*, the Declination of the Sun is 4° 13′ North. Then from 1728, I ſubtract 1676, reſts 52 Years; under which, and againſt *Septemb.* 1. (*in the Table of Variation in Years*) I find the Variation 9′ South; which ſubtracted from the afore-found Declination, 4° 13′ North, reſts 40° 4′ North, the true Declination of the Sun.

And here note, That when the Declination and Variation are both North, or both South, their Sum is the true Declination; but if the one be North, and the other South, it is their Difference.

For the Declination of the Sun out of the Meridian of London.

Anno 1696, *April* 11, at ſix of the Clock Afternoon, I would know the Sun's Declination. The 11 Day at Noon, I find it in the Kalendar, 12° 15′ North, and the 12 Day 12° 35′; therefore ſubtracting the leſſer Declination, 12° 15′, out of the greater, 12° 35′, the Reſidue 20′ is the daily Encreaſe. Then in the Table of Variation in Hours, &c. under 6 Hours in the Head, and againſt 20′ on the left-hand, I find 5′, the proportional Part; which (becauſe the Hour was Afternoon, and the Declination encreaſing) added to the afore-found 12° 15′, the Sum is 12° 20′ North, the Declination required.

Examp. For the Declination of the Sun, *Anno* 1696, *Octob.* 28. at 8 in the Morning; that is 4 Hours reckoned backward from Noon. In the Kalendar, the Declination on *Octob.* 28. that Year is 16° 39′, and on the 27 Day 16° 21′ South, the Difference is 18′; againſt which, and under 4 Hours, in the Table of Variation in Hours, &c. I find the proportional Part 3′; which (in this Example) ſubtracted from 16° 39′, there remaineth 16° 36′ South, the Declination ſought. And thus may the true Declination of the Sun be eaſily found at all times, and in all Meridians, of which I ſuppoſe here will need no more Examples. The Sun's Horizontal Parallax is only 15 Seconds, therefore the Parallax need not be applied at all. Alſo the Sun's Refraction is demonſtratively equal to that of the Fixed Stars; which latter is, by the Obſervation of *Tycho Brahe*, in the Horizon 30′, and is 0′ in 20° of Altitude. *Vid. Chap.* 8. *Sect.* 1.

A
Traverſe Table:
OR
A TABLE of Difference of *Latitude* and *Departure* to every Point and Quarter-Point of the Compaſs:

With the Uſe thereof in Working of a *Traverſe*, and Keeping a *Sea-Reckoning*.

Dist.	¼ Point.		½ Point.		¾ Point.		1 Point.		1 ¼ Point.		1 ½ Point.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.99	.05	.99	.10	.99	.15	.98	.20	.97	.24	.96	.29	1
2	1.99	.10	1.99	.20	1.98	.29	1.96	.39	1.94	.49	1.91	.58	2
3	2.99	.15	2.99	.29	2.97	.44	2.94	.59	2.91	.73	2.87	.87	3
4	3.99	.20	3.98	.39	3.96	.59	3.92	.78	3.88	.97	3.83	1.16	4
5	4.99	.25	4.98	.49	4.95	.73	4.90	.98	4.85	1.22	4.79	1.46	5
6	5.99	.29	5.97	.59	5.94	.88	5.89	1.17	5.82	1.46	5.74	1.74	6
7	6.99	.34	6.97	.69	6.92	1.03	6.87	1.37	6.79	1.70	6.70	2.03	7
8	7.99	.39	7.96	.78	7.91	1.17	7.85	1.56	7.76	1.94	7.66	2.32	8
9	8.99	.44	8.96	.88	8.90	1.32	8.83	1.76	8.73	2.19	8.62	2.61	9
10	9.99	.49	9.95	.98	9.89	1.47	9.81	1.95	9.70	2.43	9.77	2.90	10
11	10.98	.54	10.94	1.08	10.88	1.62	10.79	2.15	10.67	2.67	10.53	3.19	11
12	11.98	.59	11.94	1.18	11.87	1.76	11.77	2.34	11.64	2.92	11.48	3.48	12
13	12.98	.64	12.94	1.27	12.86	1.91	12.75	2.54	12.61	3.16	12.44	3.77	13
14	13.98	.69	13.93	1.37	13.85	2.06	13.73	2.73	13.58	3.40	13.40	4.06	14
15	14.98	.73	14.93	1.47	14.84	2.20	14.71	2.93	14.55	3.65	14.36	4.36	15
16	15.98	.78	15.92	1.57	15.83	2.35	15.70	3.12	15.52	3.89	15.31	4.64	16
17	16.98	.83	16.92	1.67	16.81	2.50	16.68	3.32	16.49	4.13	16.27	4.93	17
18	17.98	.88	17.91	1.76	17.80	2.64	17.66	3.57	17.46	4.37	17.23	5.22	18
19	18.98	.93	18.91	1.86	18.79	2.79	18.64	3.71	18.43	4.62	18.19	5.51	19
20	19.98	.98	19.90	1.96	19.78	2.93	19.62	3.90	19.40	4.86	19.14	5.81	20
21	20.97	1.03	20.89	2.06	20.77	3.08	20.60	4.10	20.37	5.10	20.10	6.10	21
22	21.97	1.08	21.89	2.16	21.76	3.22	21.58	4.29	21.34	5.35	21.05	6.39	22
23	22.97	1.13	22.89	2.25	22.75	3.37	22.56	4.49	22.31	5.59	22.01	6.68	23
24	23.97	1.18	23.88	2.35	23.74	3.52	23.54	4.68	23.28	5.83	22.97	6.79	24
25	24.97	1.22	24.88	2.45	24.73	3.66	24.52	4.88	24.25	6.08	23.93	7.27	25
26	25.97	1.27	25.87	2.55	25.72	3.81	25.51	5.07	25.22	6.32	24.88	7.55	26
27	26.97	1.32	26.87	2.65	26.70	3.66	26.49	5.27	26.19	6.56	25.84	7.84	27
28	27.97	1.37	27.86	2.74	27.69	4.10	27.47	5.46	27.16	6.80	26.80	8.13	28
29	28.97	1.42	28.86	2.84	28.68	4.25	28.45	5.66	28.13	7.05	27.76	8.42	29
30	29.96	1.47	29.85	2.94	29.67	4.40	29.42	5.85	29.10	7.29	28.71	8.71	30
31	30.95	1.52	30.84	3.04	30.66	4.55	30.40	6.05	30.07	7.53	29.67	9.00	31
32	31.95	1.57	31.84	3.14	31.65	4.69	31.38	6.24	31.04	7.78	30.62	9.29	32
33	32.95	1.62	32.84	3.23	32.64	4.84	32.36	6.44	32.01	8.02	31.58	9.58	33
34	33.95	1.67	33.83	3.33	33.63	4.99	33.34	6.63	33.98	8.26	32.54	9.18	34
35	34.95	1.71	34.83	3.43	34.62	5.13	34.32	6.83	33.95	8.51	33.50	10.17	35
36	35.95	1.76	35.82	3.53	35.61	5.28	35.31	7.02	34.92	8.75	34.45	10.45	36
37	36.95	1.81	36.82	3.63	36.59	5.43	36.29	7.22	35.89	8.99	35.41	10.74	37
38	37.95	1.86	37.81	3.72	37.58	5.57	37.27	7.41	36.86	9.23	36.37	11.03	38
39	38.95	1.91	38.81	3.82	38.57	5.72	38.25	7.61	37.83	9.48	37.33	11.32	39
40	39.95	1.96	39.81	3.92	39.57	5.87	39.23	7.80	38.80	9.72	38.28	11.61	40
41	40.94	2.01	40.80	4.02	40.56	6.02	40.21	8.00	39.77	9.96	39.24	11.90	41
42	41.94	2.06	41.80	4.12	41.55	6.16	41.19	8.19	40.74	10.21	40.19	12.19	42
43	42.94	2.11	42.80	4.21	42.54	6.31	42.17	8.39	41.71	10.45	41.15	12.48	43
44	43.94	2.11	43.79	4.31	43.53	6.46	43.15	8.58	42.68	10.69	42.11	12.77	44
45	44.94	2.20	44.79	4.41	44.52	6.60	44.13	8.78	43.65	10.94	43.07	13.07	45
46	45.94	2.25	45.78	4.51	45.51	6.75	45.12	8.97	44.62	11.18	44.02	13.35	46
47	46.94	2.30	46.78	4.61	46.49	6.90	46.10	9.17	45.59	11.42	44.98	13.64	47
48	47.94	2.35	47.77	4.70	47.48	7.04	47.08	9.36	46.56	11.66	45.94	13.93	48
49	48.94	2.40	48.77	4.80	48.47	7.19	48.06	9.56	47.53	11.91	46.90	14.22	49
50	49.94	2.45	49.76	4.90	49.46	7.43	49.04	9.76	48.50	12.15	47.85	14.51	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
	7 ¾ Point.		7 ½ Point.		7 ¼ Point.		7 Point.		6 ¾ Point.		6 ½ Point.		

Dist.	¼ Point.		½ Point.		¾ Point.		1 Point.		1 ¼ Point.		1 ½ Point.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.93	2.50	50.75	5.00	50.45	7.49	50.02	9.96	49.47	12.93	48.81	14.80	51
52	51.93	2.55	51.75	5.10	51.44	7.63	51.00	10.15	50.44	12.64	49.76	15.09	52
53	52.93	2.60	52.75	5.19	52.43	7.78	51.98	10.35	51.41	12.88	50.72	15.38	53
54	53.93	2.65	53.74	5.29	53.42	7.93	52.96	10.55	52.38	13.12	51.68	15.67	54
55	54.93	2.69	54.74	5.39	54.41	8.07	53.94	10.74	53.35	13.37	52.64	15.97	55
56	55.93	2.74	55.73	5.49	55.40	8.22	54.93	10.94	54.32	13.61	53.59	16.25	56
57	56.93	2.79	56.73	5.59	56.38	8.37	55.91	11.13	55.29	13.85	54.55	16.54	57
58	57.93	2.84	57.72	5.68	57.37	8.51	56.89	11.33	56.26	14.09	55.51	16.83	58
59	58.93	2.89	58.72	5.78	58.36	8.66	57.87	11.52	57.23	14.34	56.47	17.12	59
60	59.93	2.94	59.71	5.88	59.35	8.80	58.85	11.71	58.20	14.58	57.42	17.42	50
61	60.92	2.99	60.70	5.98	60.34	8.95	59.83	11.91	59.17	14.82	58.38	17.71	61
62	61.92	3.04	61.70	6.08	61.33	9.09	60.81	12.10	60.14	15.07	59.33	18.00	62
63	62.92	3.09	62.70	6.17	62.32	9.24	61.79	12.30	61.11	15.31	60.29	18.29	63
64	63.92	3.14	63.69	6.27	63.31	9.39	62.77	12.49	62.08	15.55	61.25	18.58	64
65	64.92	3.18	64.69	6.37	64.30	9.53	63.75	12.69	63.05	15.80	62.21	18.88	65
66	65.92	3.23	65.68	6.47	65.29	9.68	64.74	12.88	64.02	16.04	63.16	19.16	66
67	66.92	3.28	66.68	6.57	66.27	9.83	65.72	13.08	64.99	16.28	64.12	19.45	67
68	67.92	3.33	67.67	6.66	67.26	9.97	66.70	13.27	65.96	16.52	65.08	19.74	68
69	68.92	3.38	68.67	6.76	68.25	10.12	67.68	13.47	66.93	16.77	66.04	20.03	69
70	69.92	3.43	69.66	6.86	69.24	10.27	68.66	13.66	67.90	17.01	66.98	20.32	70
71	70.91	3.48	70.65	6.96	70.23	10.42	69.64	13.86	68.87	17.25	67.94	20.61	71
72	71.91	3.53	71.65	7.06	71.22	10.56	70.62	14.05	69.84	17.50	68.89	20.90	72
73	72.91	3.58	72.65	7.15	72.21	10.71	71.60	14.25	70.81	17.74	69.85	21.19	73
74	73.91	3.63	73.64	7.25	73.20	10.86	72.58	14.45	71.78	17.98	70.81	21.48	74
75	74.91	3.67	74.64	7.35	74.19	11.00	73.56	14.64	72.75	18.23	71.77	21.78	75
76	75.91	3.72	75.63	7.45	75.18	11.15	74.55	14.84	73.72	18.47	72.72	22.06	76
77	76.91	3.77	76.63	7.55	76.16	11.30	75.53	15.03	74.69	18.71	73.68	22.35	77
78	77.91	3.82	77.62	7.64	77.15	11.44	76.51	15.23	75.66	18.95	74.64	22.64	78
79	78.91	3.87	78.62	7.74	78.14	11.59	77.49	15.42	76.63	19.20	75.60	22.93	79
80	79.90	3.92	79.61	7.84	79.13	11.74	78.46	15.61	77.60	19.44	76.56	23.22	80
81	80.89	3.97	80.60	7.94	80.12	11.89	79.44	15.81	78.57	19.68	77.52	23.51	81
82	81.89	4.02	81.60	8.04	81.11	12.03	80.42	16.00	79.54	19.93	78.47	23.80	82
83	82.89	4.07	82.60	8.13	82.10	12.18	81.40	16.20	80.51	20.27	79.43	24.09	83
84	83.89	4.12	83.59	8.23	83.09	12.33	82.38	16.39	81.48	20.41	80.39	24.38	84
85	84.89	4.16	84.59	8.33	84.08	12.47	83.36	16.59	82.45	20.66	81.35	24.68	85
86	85.89	4.21	85.58	8.43	85.07	12.62	84.35	16.78	83.42	20.90	82.30	24.96	86
87	86.89	4.26	86.58	8.53	86.05	12.77	85.33	16.98	84.39	21.14	83.26	25.25	87
88	87.89	4.31	87.57	8.62	87.04	12.91	86.31	17.17	85.36	21.38	84.22	25.54	88
89	88.89	4.36	88.57	8.72	88.03	13.06	87.29	17.37	86.33	21.63	85.18	25.83	89
90	89.89	4.42	89.57	8.82	89.03	13.21	88.27	17.56	87.30	21.87	86.13	26.13	90
91	90.88	4.47	90.56	8.92	90.02	13.36	89.25	17.76	88.27	22.11	87.09	20.42	91
92	91.88	4.52	91.56	9.02	91.01	13.50	90.23	17.95	89.24	22.36	88.04	26.71	92
93	92.88	4.57	92.56	9.11	92.00	13.65	91.21	18.14	90.21	22.60	89.00	27.00	93
94	93.88	4.62	93.55	9.21	92.99	13.80	92.19	18.34	91.18	22.84	89.96	27.29	94
95	94.88	4.66	94.55	9.31	93.98	13.04	93.17	18.53	92.15	23.09	90.92	27.59	95
96	95.88	4.71	95.54	9.41	94.97	14.09	94.16	18.73	93.12	23.33	91.87	27.87	96
97	96.88	4.76	96.54	9.51	95.95	14.24	95.14	18.92	94.09	23.57	92.83	28.16	97
98	97.88	4.81	97.53	9.60	96.94	14.38	96.12	19.12	95.06	23.81	93.79	28.45	98
99	98.88	4.86	98.53	9.70	97.93	14.53	97.10	19.32	96.03	24.06	94.75	28.74	99
100	99.88	4.91	99.52	9.80	98.92	14.67	98.08	19.51	97.00	24.30	95.69	29.03	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
	7 ¾ Point.		7 ½ Point.		7 ¼ Point.		7 Point.		6 ¾ Point.		6 ½ Point.		

Diſt.	1 ¾ Point.		2 Point.		2 ¼ Point.		2 ½ Point.		2 ¾ Point.		3 Point.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.94	.34	.92	.38	.96	.43	.88	.47	.86	.51	.83	.56	1
2	1.81	.67	1.85	.77	1.89	.86	1.76	.94	1.72	1.03	1.66	1.11	2
3	2.83	.01	2.77	1.15	2.71	1.28	2.65	1.41	2.57	1.54	2.49	1.67	3
4	3.77	1.35	3.70	1.53	3.62	1.71	3.53	1.89	3.43	2.06	3.33	2.22	4
5	4.71	1.69	4.62	1.91	4.52	2.14	4.41	2.36	4.29	2.57	4.16	2.78	5
6	5.65	2.02	5.54	2.30	5.42	2.57	5.29	2.83	5.15	3.08	4.99	3.33	6
7	6.59	2.36	6.47	2.68	6.33	2.99	6.17	3.30	6.00	3.60	5.82	3.89	7
8	7.53	2.70	7.39	3.06	7.23	3.42	7.06	3.77	6.86	4.11	6.65	4.44	8
9	8.47	3.03	8.32	3.44	8.14	3.85	7.94	4.24	7.72	4.63	7.48	5.00	9
10	9.42	3.37	9.24	3.83	9.04	4.28	8.82	4.71	8.58	5.14	8.31	5.56	10
11	10.36	3.71	10.16	4.21	9.94	4.71	9.70	5.18	9.44	5.65	9.14	6.12	11
12	11.30	4.04	11.09	4.60	10.85	5.14	10.58	5.65	10.30	6.17	9.97	6.67	12
13	12.25	4.38	12.01	4.98	11.75	5.56	11.47	6.12	11.15	6.68	10.80	7.23	13
14	13.19	4.72	12.94	5.36	12.66	5.99	12.35	6.60	12.01	7.20	11.64	7.78	14
15	14.13	5.06	13.86	5.74	13.56	6.42	13.23	7.07	12.87	7.71	12.47	8.34	15
16	15.07	5.39	14.78	6.13	14.46	6.65	14.11	7.54	13.73	8.22	13.30	8.89	16
17	16.01	5.73	15.71	6.51	15.37	7.27	14.99	8.01	14.58	8.74	14.13	9.45	17
18	16.95	6.07	16.63	6.89	16.27	7.70	15.88	8.48	15.44	9.25	14.96	10.00	18
19	17.89	6.40	17.56	7.27	17.18	8.13	16.76	8.95	16.30	9.77	15.79	10.56	19
20	18.88	6.74	18.48	7.65	18.08	8.55	17.64	9.43	17.15	10.28	16.63	11.11	20
21	19.77	7.08	19.40	8.03	18.98	8.98	18.52	9.90	18.01	10.79	17.46	11.67	21
22	20.71	7.41	20.34	8.42	19.89	9.41	19.40	10.37	18.87	11.31	18.29	12.22	22
23	21.66	7.75	21.25	8.80	20.79	9.83	20.29	10.84	19.72	11.82	19.12	12.78	23
24	22.60	8.09	22.18	9.18	21.70	10.26	21.17	11.32	20.58	12.34	19.96	13.33	24
25	23.54	8.43	23.10	9.56	22.69	10.69	22.05	11.79	21.44	12.85	20.79	13.89	25
26	24.48	8.76	24.02	9.95	23.50	11.12	22.93	12.26	22.30	13.36	21.62	14.44	26
27	25.42	9.10	24.95	10.33	24.41	11.54	23.81	12.73	23.15	13.88	22.45	15.00	27
28	26.36	9.45	25.87	10.71	25.31	11.97	24.70	13.20	24.01	14.39	23.28	15.55	28
29	27.30	9.77	26.80	11.09	26.22	12.40	25.58	13.67	24.87	14.91	24.11	16.11	29
30	28.25	10.11	27.72	11.48	27.12	12.83	26.46	14.14	25.73	15.42	24.94	16.67	30
31	29.19	10.45	28.64	11.86	28.02	13.26	27.34	14.61	26.59	15.93	25.77	17.23	31
32	30.13	10.78	29.57	12.25	28.93	13.69	28.22	15.08	27.45	16.45	26.60	17.78	32
33	31.08	11.12	30.49	12.63	29.83	14.11	29.11	15.55	28.30	16.96	27.43	18.34	33
34	32.02	11.46	31.42	13.01	30.74	14.54	29.99	16.03	29.16	17.48	28.27	18.89	34
35	32.96	11.80	32.34	13.39	31.64	14.97	30.87	16.50	30.02	17.99	29.10	19.45	35
36	33.90	12.13	33.26	13.78	32.54	15.40	31.75	16.97	30.88	18.50	29.93	20.00	36
37	34.84	12.47	34.19	14.16	33.45	15.82	32.63	17.44	31.73	19.02	30.76	20.56	37
38	35.78	12.81	35.11	14.54	34.35	16.25	33.52	17.91	32.59	19.53	31.59	21.11	38
39	36.72	13.14	36.04	14.92	35.26	16.68	34.40	18.38	33.45	20.05	32.42	21.67	39
40	37.66	13.48	36.95	15.31	36.16	17.10	35.27	18.86	34.31	20.56	33.26	22.22	40
41	38.66	13.82	37.87	15.69	37.06	17.53	36.15	19.33	35.17	21.07	34.09	22.78	41
42	39.54	14.10	38.80	16.08	37.97	17.96	37.03	19.80	36.03	21.59	34.92	23.33	42
43	40.49	14.49	39.72	16.46	38.87	18.38	37.92	20.27	36.88	22.10	35.75	23.89	43
44	41.43	14.84	40.65	16.84	39.78	18.81	38.80	20.75	37.74	22.62	36.59	24.44	44
45	42.37	15.17	41.57	17.22	40.68	19.24	39.68	21.22	38.60	23.13	37.42	25.00	45
46	43.31	15.50	42.49	17.61	41.58	19.67	40.56	21.69	39.46	23.64	38.25	25.55	46
47	44.25	15.84	43.42	17.99	42.49	20.09	41.44	22.16	40.31	24.16	39.08	26.11	47
48	45.19	16.17	44.34	18.37	43.39	20.52	42.33	22.63	41.17	24.67	39.91	26.66	48
49	46.13	16.50	45.26	18.75	44.30	20.95	43.20	23.10	42.03	25.19	40.74	27.22	49
50	47.08	16.85	46.19	19.14	45.20	21.38	44.10	23.57	42.89	25.71	41.57	27.78	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
	6 ¼ Point.		6 Point.		5 ¾ Point.		5 ½ Point.		5 ¼ Point.		5 Point.		

Dist.	1 ¾ Point.		2 Point.		2 ¼ Point.		2 ½ Point.		2 ¾ Point.		3 Point.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	48.02	17.19	47.11	19.52	46.10	21.81	44.98	24.04	43.75	26.21	42.40	28.33	51
52	48.96	17.52	48.04	19.91	47.01	22.24	45.86	24.51	44.61	26.74	43.23	28.89	52
53	49.91	17.86	48.96	20.29	47.91	22.66	46.75	24.98	45.46	27.25	44.06	29.45	53
54	50.85	18.20	49.89	20.67	48.82	23.09	47.63	25.46	46.32	27.77	44.90	30.00	54
55	51.79	18.54	50.81	21.05	49.72	23.52	48.51	25.93	47.18	28.28	45.73	30.56	55
56	52.73	18.87	51.73	21.44	50.62	23.95	49.39	26.40	48.04	28.79	46.56	31.11	56
57	53.67	19.21	52.68	21.82	51.53	24.37	50.27	26.87	48.89	29.31	47.39	31.67	57
58	54.61	19.55	53.58	22.20	52.43	24.80	51.16	27.34	49.75	29.82	48.22	32.22	58
59	55.55	19.88	54.51	22.57	53.34	25.23	52.04	27.81	50.61	30.34	48.04	32.78	59
60	56.49	20.21	55.43	22.96	54.24	25.65	52.91	28.28	51.46	30.85	49.89	33.33	60
61	57.43	20.55	56.35	23.34	55.14	26.07	53.79	28.75	52.32	31.36	50.72	33.89	61
62	58.37	20.88	57.28	23.73	56.05	26.51	54.69	29.22	53.18	31.88	51.55	34.44	62
63	59.32	21.22	58.20	24.11	56.95	26.93	55.56	29.69	54.03	32.39	52.36	35.00	63
64	60.26	21.56	59.13	24.49	57.86	27.36	56.44	30.17	54.89	32.91	53.22	35.55	64
65	61.20	21.90	60.05	24.87	58.76	27.79	57.32	30.54	55.75	33.42	54.05	36.11	65
66	62.14	22.23	60.97	25.26	59.66	28.22	58.20	31.11	56.61	33.93	54.88	36.66	66
67	63.08	22.57	61.90	25.64	60.57	28.64	59.08	31.58	57.46	34.45	55.71	37.22	67
68	64.02	22.91	62.82	26.02	61.47	29.07	60.97	32.05	58.32	34.96	56.54	37.77	68
69	64.96	23.24	63.75	26.40	62.38	29.50	60.85	32.52	59.18	35.48	57.37	38.33	69
70	65.91	23.58	64.67	26.79	63.28	29.93	61.73	33.00	60.04	35.99	58.20	38.89	70
71	66.85	23.92	65.59	27.17	64.18	30.36	62.61	33.47	60.90	36.50	59.03	39.45	71
72	67.79	24.25	66.52	27.56	65.09	30.79	63.49	33.94	61.76	37.02	59.83	40.00	72
73	68.74	24.59	67.44	27.94	65.99	31.21	64.38	34.41	62.61	37.53	60.69	40.56	73
74	69.68	24.93	68.37	28.32	66.90	31.64	65.26	34.89	63.47	38.05	61.53	41.11	74
75	70.62	25.27	69.29	28.70	67.80	32.07	66.14	35.36	64.33	38.56	62.36	41.67	75
76	71.56	25.60	70.21	29.09	68.70	32.48	67.02	35.83	65.19	39.07	63.19	42.22	76
77	72.50	25.94	71.14	29.47	69.61	32.92	67.90	36.30	66.04	39.59	64.02	42.78	77
78	73.44	26.28	72.06	29.85	70.51	33.35	68.79	36.77	66.90	40.10	64.85	43.33	78
79	74.38	26.61	72.99	30.23	71.42	33.78	69.67	37.24	67.76	40.62	65.67	43.89	79
80	75.32	26.95	73.91	30.62	72.32	34.21	70.55	37.71	68.62	41.13	66.52	44.45	80
81	76.26	27.29	74.83	31.00	73.22	34.64	71.43	38.18	69.48	41.64	67.35	45.00	81
82	77.20	27.62	75.76	31.39	74.13	35.07	72.31	38.65	70.34	42.16	68.18	45.55	82
83	78.15	27.96	76.68	31.77	75.03	35.49	73.20	39.12	71.19	42.67	68.99	46.11	83
84	79.09	28.30	77.61	32.15	75.94	35.92	74.08	39.60	72.05	43.19	69.85	46.66	84
85	80.08	28.64	78.58	32.53	76.84	36.35	74.96	40.07	72.91	43.70	70.68	47.22	85
86	80.97	28.97	79.45	32.92	77.74	36.78	75.84	40.54	73.77	44.21	71.51	47.77	86
87	81.91	29.31	80.38	33.30	78.65	37.20	76.72	41.01	74.62	44.73	72.34	48.33	87
88	82.85	29.65	81.30	33.68	79.55	37.63	77.61	41.48	75.48	45.24	73.17	48.88	88
89	83.79	29.98	82.23	34.06	80.46	38.06	78.49	41.95	76.34	45.70	74.00	49.44	89
90	84.74	30.32	83.15	34.44	81.36	38.48	79.37	42.42	77.20	46.27	74.83	50.00	90
91	85.68	30.66	84.07	34.82	82.26	38.91	80.25	42.80	78.06	46.78	75.66	50.56	91
92	86.62	30.99	85.00	35.21	83.17	39.34	81.13	43.36	78.92	47.30	76.46	51.11	92
93	87.57	31.33	85.92	35.59	84.07	39.76	82.02	43.83	79.77	47.81	77.32	51.67	93
94	88.51	31.67	86.85	35.97	84.98	40.19	82.90	44.31	80.63	48.33	78.16	52.22	94
95	89.45	32.01	87.77	36.35	85.88	40.62	83.78	44.78	81.49	48.84	78.99	52.78	95
96	90.39	32.34	88.69	36.74	86.78	41.05	84.66	45.25	82.35	49.35	79.82	53.33	96
97	91.33	32.68	89.62	37.12	87.69	41.47	85.54	45.72	83.20	49.87	80.65	53.89	97
98	92.27	33.02	90.54	37.50	88.59	41.90	86.43	46.19	84.06	50.38	81.48	54.44	98
99	93.21	33.35	91.47	38.88	89.50	42.33	87.31	46.66	84.92	50.90	82.30	55.00	99
100	94.16	33.69	92.39	38.27	90.40	42.16	88.18	47.14	85.77	51.41	83.15	55.56	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
	6 ¼ Point.		6 Point.		5 ¾ Point.		5 ½ Point.		5 ¼ Point.		5 Point.		

Diſt.	3 ¼ Point.		3 ½ Point.		3 ¾ Point.		4 Point.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	0.80	.60	.77	.63	.74	.67	.71	.71	1
2	1.61	1.19	1.55	1.27	1.48	1.34	1.41	1.41	2
3	2.41	1.79	2.32	1.90	2.22	2.01	2.12	2.12	3
4	3.21	2.38	3.09	2.54	2.96	2.69	2.83	2.83	4
5	4.02	2.98	3.86	3.17	3 70	3.36	3.53	3.53	5
6	4.82	3.57	4.64	3.81	4.45	4.03	4 24	4.24	6
7	5.62	4.17	5.41	4.44	5.19	4.70	4.95	4.95	7
8	6.43	4.77	6.18	5.07	5.93	5.37	5.66	5.66	8
9	7.23	5.36	6.96	5.71	6.67	6.04	6.36	6.36	9
10	8.03	5.96	7.73	6.34	7.41	6.72	7.07	7.07	10
11	8.83	6.56	8.50	6.97	8.15	7.39	7.78	7.78	11
12	9.64	7.15	9 28	7.61	8.89	8.06	8.48	8.48	12
13	10.44	7.75	10.05	8.24	9.63	8.73	9.19	9.19	13
14	11.24	8.34	10.82	8.88	10.37	9.41	9.90	9.90	14
15	12.05	8.94	11.59	9.51	11.11	10.08	10.60	10.60	15
16	12.85	9.53	12.37	10.15	11.86	10.75	11 31	11.31	16
17	13.65	10.13	13 14	10.78	12.60	11.42	12.02	12.02	17
18	14.46	10.73	13 91	11.41	13.34	12.09	12.73	12.73	18
19	15.26	11.32	14.69	12.05	14.08	12.76	13.43	13.47	19
20	16.06	11.91	15.46	12.69	14.82	13.43	14.14	14.14	20
21	16.86	12.51	16.23	13.32	15.56	14.10	14.85	14.85	21
22	17.67	13.10	17.01	13.96	16.30	14.77	15.55	15.55	22
23	18.47	13.70	17.78	14.59	17.04	15.44	16.26	16.26	23
24	19.27	14.29	18.55	15.23	17.78	16.12	16 97	16.97	24
25	20.08	14.89	19.32	15.86	18.52	16.79	17.67	17.67	25
26	20.88	15.48	20.10	16.50	19.27	17.43	18.38	18.38	26
27	21.68	16.08	20.87	17.13	20.01	18.13	19.09	19.09	27
28	22.48	16.68	21.64	17.76	20 75	18.80	19.80	19.80	28
29	23.28	17.27	22.42	18.40	21.49	19.47	20.50	20.50	29
30	24.10	17.87	23.19	19.03	22.23	20.15	21.21	21.21	30
31	24.89	18.47	23.96	19.66	22.97	20 82	21.92	21.92	31
32	25.70	19.06	24 74	20.30	23.71	21.49	22.62	22.62	32
33	26.50	19.66	25.51	20.93	24.45	22.16	23.33	23.33	33
34	27.30	20.25	26.28	21.57	25.19	22.84	24.04	24.04	34
35	27.11	20.85	27.05	22.20	25.93	23.51	24.74	24.74	35
36	28.91	21.44	27.83	22.84	26.68	24.18	25.45	25.45	36
37	29.71	22.04	28.60	23.47	27.42	24.85	26.06	26.16	37
38	30.51	22.64	29.37	24.10	28.16	25.52	26.87	26.87	3[illegible]
39	31.31	23.23	30.15	24.74	28.90	26.19	27.57	27.57	39
40	32.13	23.83	30.92	25.38	29.64	26.86	28.28	28.28	40
41	32.92	24.43	31.69	26 01	30.38	27.53	28.99	28.99	41
42	33.73	25.02	32.47	26.65	31.12	28.20	29.69	29.69	42
43	34.53	25.62	33.24	27.28	31.86	28.87	30.40	30.40	43
44	35.33	26.21	34.01	27.92	32.60	29.55	31.11	31.11	44
45	36.14	26.81	34.78	28.55	33.34	30.22	31.81	31.81	45
46	36.94	27.40	35.56	29.19	34.09	30.86	32.52	32.52	46
47	37.74	28.00	36.33	29.82	34.83	31.56	33.23	33.23	47
48	38.54	28.60	37.10	30.45	35.57	32.23	33.94	33.94	48
49	39.34	29.19	37.88	31.09	36.31	32.90	34.64	34.64	49
50	40.16	29.78	38.65	31.72	37.05	33.58	35.35	35.35	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
	4 ¾ Point.		4 ½ Point.		4 ¼ Point.		4 Point.		

Diſt.	3 ¼ Point.		3 ½ Point.		3 ¾ Point.		4 Point.		Diſt.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	40.96	30.38	39.42	32.35	37.79	34.25	36.06	36.06	51
52	41.77	30.97	40.20	32.99	38.53	34.92	36.76	36.76	52
53	42.57	31.57	40.97	33.62	39.27	35.59	37.47	37.47	53
54	43.37	32.16	41.74	34.26	40.01	36.27	38.18	38.18	54
55	44.18	32.76	42.51	34.89	40.75	36.94	38.88	38.88	55
56	44.98	33.35	43.29	35.53	41.50	37.61	39.59	39.59	56
57	45.78	33.95	44.06	36.16	42.24	38.28	40.30	40.30	57
58	46.58	34.55	44.83	36.79	42.97	38.95	41.01	41.01	58
59	47.39	35.14	45.61	37.43	43.72	39.62	41.71	41.71	59
60	48.19	35.74	46.38	38.06	44.46	40.29	42.43	42.43	60
61	48.99	36.34	47.15	38.69	45.20	40.96	43.14	43.14	61
62	49.80	36.93	47.93	39.33	45.94	41.63	43.84	43.84	62
63	50.60	37.53	48.70	39.96	46.68	42.30	44.55	44.30	63
64	51.40	38.12	49.47	40.60	47.42	42.98	45.26	45.26	64
65	52.21	38.72	50.24	41.23	48.16	43.65	45.96	45.96	65
66	53.01	39.31	51.02	41.87	48.91	44.29	46.67	46.67	66
67	53.81	39.91	51.79	42.50	49.65	44.99	47.38	47.38	67
68	54.62	40.51	52.56	43.13	50.39	45.66	48.09	48.09	68
69	55.42	41.10	53.34	43.77	51.13	46.33	48.79	48.79	69
70	56.23	41.70	54.11	44.41	51.87	47.01	49.50	49.50	70
71	57.03	42.30	54.88	45.04	52.61	47.68	50.21	50.21	71
72	57.84	42.89	55.66	45.68	53.35	48.35	50.91	50.91	72
73	58.64	43.49	56.43	46.31	54.09	49.02	51.62	51.62	73
74	59.44	44.08	57.20	46.95	54.83	49.70	52.33	52.33	74
75	60.25	44.68	57.97	47.58	55.57	50.37	53.03	53.03	75
76	61.05	45.27	58.75	48.22	56.32	51.04	53.74	53.74	76
77	61.85	45.87	59.52	48.85	57.06	51.71	54.45	54.45	77
78	62.66	46.47	60.29	49.48	57.80	52.38	55.16	55.16	78
79	63.46	47.06	61.07	50.12	58.54	53.05	55.86	55.86	79
80	64.26	47.66	61.84	50.75	59.28	53.72	56.57	56.57	80
81	65.06	48.26	62.61	51.38	60.02	54.39	57.28	57.28	81
82	65.87	48.85	63.39	52,02	60.76	55.06	57.98	57.98	82
83	66.67	49.45	64.16	52.65	61.50	55.73	58.69	58.69	83
84	67.47	50.04	64.93	53.29	62.24	56.41	59.40	59.40	84
85	68.28	50.64	65.70	53.92	62.98	57.08	60.10	60.10	85
86	69.08	51.23	66.48	54.56	63.73	57.72	60.81	60.81	86
87	69.88	51.83	67.25	55.19	64.47	58.42	61.52	61.52	87
88	70.69	52.43	68.02	55.82	65.21	59.09	62.23	62.23	88
89	71.49	53.02	68.80	56.46	65.95	59.76	62.93	62.93	89
90	72.29	53.61	69.57	57.10	66.69	60.44	63.64	63.64	90
91	73.09	54.21	70.34	57.73	67.43	61.11	64.35	64.35	91
92	73.90	54.80	71.12	58.37	68.17	61.78	65.05	65.05	92
93	74.70	55.40	71.89	59.00	68.91	62.45	65.76	65.76	93
94	75.50	55.99	72.66	59.64	69.65	63.13	66.47	66.47	94
95	76.31	56.59	73.43	60.27	70.39	63.80	67.17	67.17	95
96	77.11	57.18	74.21	60.91	71.14	64.47	67.88	67.88	96
97	77.91	57.78	74.98	61.54	71.88	65.14	68.59	68.59	97
98	78.72	58.38	75.75	62.17	72.62	65.81	69.30	69.30	98
99	79.52	58.97	76.53	62.81	73.36	66.48	70.00	70.00	99
100	80.32	59.57	77.30	63.44	74.10	67.16	70.71	73.71	100
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
	4 ¾ Point.		4 ½ Point.		4 ¼ Point.		4 Point.		

The Uſe of the preceding Table of Difference of Latitude and Departure.

THIS is a large Table, giving the Difference of Latitude and Departure to any Diſtance not exceeding 10000, and to every Quarter-Point of the Compaſs.

The Courſe ſtands at the Head and Foot of the Table; at the Head it begins at ¼ Point, ſo ½ Point, ¾ Point, increaſing to 4 Points; at the Foot it begins at 4 Points, ſo 4 ¼ Points, 4 ½ Points, increaſing backwards to 7 ¾ Points. The Diſtance is placed in the two outermoſt Columns of each Page, under the word ***Diſtant***, on the left-hand Page, beginning at 1, and increaſing to 50; on the right-hand Page, beginning at 51, and increaſing to 100. The Difference of Latitude and Departure ſtands under the Courſe at the Head of the Table, and over the Courſe at the Foot thereof, diſtinguiſhed by the words ***Lat.*** and ***Dep.***

1. In this Table, if your Diſtance exceed not 100 Miles or Leagues, the Difference of Latitude and Departure will be given in Miles or Leagues, and 100 Parts of a Mile or League: But it may ſuffice, if the Difference of Latitude and Departure be taken only to Miles or Leagues, and tenth Parts of a Mile or League, with this Allowance, that if the Parts be 16 or more, inſtead thereof ſet down 2 Tenths, (which is 20 hundred Parts); if *26*, or more, *3* Tenths; if *36*, or more, 4 Tenths; if *46*, or more, 5 Tenths; if *56*, or more, *6* Tenths; if *66*, or more, 7 Tenths; if *76*, or more, 8 Tenths; if 86, or more, 9 Tenths; if *96*, or more, then make the Miles or Leagues of Difference of Latitude or Departure, 1 more than they are in the Table: As for inſtance, inſtead of 19.16, ſet down 19.2 Tenths; for 27.27, place 27.3; for 49.59, place *49.6*; for 52.72, place 52.8; for *76.96*, place 77; for 78.*96*, place 79 Miles or Leagues.

2. If the Diſtance be above 100, and not exceeding 1000, this Table gives the Difference of Latitude and Departure in Miles or Leagues, and tenth Parts, being taken out at twice.

3. If the Diſtance be more than 1000, and exceeds not 10000, the Difference of Latitude and Departure is given in Miles or Leagues, as ſhall be explained by what follows.

This Table is very uſeful in the reſolving theſe 6 *Problems* in Navigation following; provided, in the 5 laſt *Problems*, the Diſtance either given or required exceeds not 100 Miles or Leagues.

Problem I.

The Courſe and Diſtance given; to find the Difference of Latitude and Departure.

Example 1.

A Ship ſails W. S.W. $\frac{1}{2}$ *Weſt*, 50 *Miles; to find the Difference of Latitude, and the Departure.*

On the left-hand Page of the Table, over 6 $\frac{1}{2}$ Points, and right againſt 50 Miles diſtance, you will find over the word *Lat.* 14.51, and over *Dep.* 47.85; which being contracted according to the firſt Rule foregoing, ſhews your Diff. of Lat. to be 14.5 Tenths, and your Departure 47.8 Tenths, as was required.

Example 2.

A Ship ſails E. by N. half Eaſt, 125 *Miles; to find the Difference of Latitude and Departure.*

This muſt be taken out of the Table at twice, after this following manner:

To perform this, you muſt account 1 at the beginning of the Table to be 10; and 2 to be 20; 3, 30; 4, 40; 5, 50: And ſo 10 to be 100; 11, 110; 12, 120; and 20 to be 200; 30, 300; 40, 400; 50, 500; 60, 600; 70, 700; 80, 800; 90, 900; and 100 at the end, to be 1000.

According to this Direction, againſt 12 (which ſtands for 120) on the left-hand Page, over 7 $\frac{1}{2}$ Points, ſtands 1.18 over *Lat.* and 11.94 over *Dep.* which done, according to the ſecond Rule before given, your Difference of Latitude is 11.8, and your Departure 119.4. Then take out the Diff. of Lat. and Dep. for the Remainder, which is 5, according to the firſt Rule aforegoing, and after the manner of the firſt Example of this *Problem*; ſo you will find Difference of Latitude to be 0.5, and your Departure 5.0: This done, ſet them down, and add them together after this manner.

Diſt.	Lat.	Dep.
120	11.8	119.4
5	0.5	5.0
125	12.3	124.4

So that your Difference of Latitude for the whole Diſtance 125 Miles, is 12.3 Tenths, and your Departure 124.4 Tenths.

Example 3.

A Ship ſails N. W. by N. ¾ Weſt, 976 Miles; to find the Difference of Latitude, and the Departure.

Under 3 ¼ Points, and againſt 97 (taken for 970) ſtands 77.91, and 57.78, that is the Difference of Latitude 779.1 Tenth, the Departure 577.8 Tenths; againſt 6 ſtands 4.82, and 3.57; that is, the Difference of Latitude 4.8 Tenths, the Departure 3.6 Tenths; which added together, makes the whole Difference of Latitude 783.9, and the Departure 581.4.

Example 4.

A Ship ſails N. E. by N. half Eaſt, 7968 Miles; to find the Difference of Latitude and Departure.

To perform this, you muſt account 1 at the beginning of the Table to be 100; 2, to be 200; 3, 300; 4, 400: And ſo 10 to be 1000; 11 to be 1100; 12, 1200; 13, 1300; 14, 1400: So 20 to be 2000; 30, 3000; 40, 4000; 50, 5000; 60, 6000; 70, 7000; 80, 8000; 90, 9000; and 100, 10000.

According to this Direction, againſt 79 (taken for 7900) and under 3 ½ Points, ſtands 61.07 for the Difference of Latitude, and 50.12 Miles for the Departure, according to the third Rule. Then take out the Difference of Latitude and Departure for the Remainder 68, according to the firſt Rule, which you ſhall find to be 52.6, and 43.1; ſo the whole Difference of Latitude is 6159.6 Miles, and the Departure 5055.1 Miles.

Problem II.

The Courſe and Difference of Latitude being given; to find the Diſtance and Departure.

Example.

A Ship ſails W. N. W. half Weſt, until her Difference of Latitude be 14.5 *Leagues; to find the Diſtance, and the Departure.*

Look over 6½ Points the Courſe, in the Column of Latitude, until you find 14.5, and right againſt it you will find the Diſtance 50 Leagues, and the Departure 47.8 Leagues.

Problem III.

The Courſe and Departure given; to find the Difference of Latitude, and the Diſtance.

Example.

A Ship ſails S. W. by S. ¾ W. until her Departure be 47.7 *Leagues; to find the Difference of Latitude, and Diſtance.*

Look in the Column of Departure, under 3¾ Points, until you find 47.7, and right againſt it you ſee 52.6 Leagues for the Difference of Latitude, and 71 Leagues for the Diſtance.

Problem IV.

The Difference of Latitude and Diſtance given; to find the Courſe and Departure.

Example.

A Ship ſails 50 *Leagues between the South and the Weſt, until her Difference of Latitude be* 14.5 *Leagues; to find the Courſe and Departure.*

Look over your ſeveral Columns in the Table, until right againſt 50, the Diſtance, you find 14.5 in the Column of Latitude, over the Courſe, which will be 6½ Points; and in the Column of Departure you will find your Departure to be 47.8.

Problem V.

The Diſtance and Departure given; to find the Courſe and Difference of Latitude.

Example.

A Ship ſails 80 *Leagues North Weſterly, until her Departure be* 53.7 *Leagues; to find the Courſe and Difference of Latitude.*

Look over the ſeveral Columns in the Table, until right againſt 80 the Diſtance, you find 53.7 in the Column of Departure; over it you will ſee 3 $\frac{3}{4}$ Points, or N. W. by N. $\frac{3}{4}$ W. and the Difference of Latitude (in the Column of Latitude, right againſt 80) to be 59.3 Leagues.

Problem VI.

The Difference of Latitude and Departure being given; to find the Courſe and Diſtance.

Example.

A Ship ſails between the North and the Eaſt, until her Difference of Latitude be 56.3 *Leagues, and her Departure* 51.0; *to find the Courſe and Diſtance.*

Look over your ſeveral Columns of Latitude and Departure, until you find 56.3 to ſtand againſt 51.0, or the neareſt thereto, which will be under 3 $\frac{3}{4}$ Points, which makes the Courſe N. E. by N. $\frac{3}{4}$ E. and it ſtands right againſt 76 Leagues, which is the Diſtance required.

Problem VII.

How to work a Traverſe by the Tables of Latitude and Departure.

Theſe Tables in the working of a Traverſe, are both readier and far more exact, than any Inſtrument commonly uſed for that purpoſe.

Example.

A Ship ſails S W. by S. 37′, *then S. by E.* 39′, *then S. E. by S.* $\frac{1}{2}$ *E.* 47′, *then W. by N.* 59′, *then W. N. W.* 62′, *then S. W.* $\frac{1}{2}$ *W.* 17′; *to find the Difference of Latitude and Departure, and the direct Courſe and Diſtance from the firſt Place.*

Set down the ſeveral Courſes and Diſtances, as in the following Table.

Courſe.	*Diſt.*	*North.*	*South.*	*Eaſt.*	*Weſt.*
South Weſt by South.	37		30.8		20.6
South by Eaſt.	39		38.2	07.6	
S. E. by South ½ Eaſt.	47		36.3	29.8	
Weſt by North.	59	11.5			57.9
W. N. W.	62	23.7			57.3
South-Weſt ½ Weſt.	27		17.1		20.9
		35.2	122.4	37.4	156.7
			35.2		37.4
		Diff. Lat.	87.2	Dep.	119.3

Then by *Problem* 1. find the Difference of Latitude and Departure for thoſe Courſes and Diſtances ſeverally, which place in their proper Columns, *viz.* If the Courſe be North-Eaſterly, place the Difference of Latitude in the North Column, (under *North*) the Departure in the Eaſt Column, (under *Eaſt*): If the Courſe be South-Eaſterly, place the Difference of Latitude in the South Column, (under *South*) and the Departure in the Eaſt Column. If the Courſe be North-Weſterly, place the Difference of Latitude in the North Column, and the Departure in the Weſt Column. If the Courſe be South Weſterly, place the Difference of Latitude in the South Column, and the Departure in the Weſt Column.

As for Inſtance; In the foregoing Table, the firſt Courſe is South-Weſt by South, the Diſtance 37: Becauſe the Courſe is South Weſterly, you muſt place the Difference of Latitude 30.8 in the South Column, and the Departure 20.6 in the Weſt Column, as you ſee in the Table.

The ſecond Courſe is S. by E. the Diſtance 39; therefore becauſe the Courſe is South Eaſterly, you muſt place the Difference of Latitude in the South Column, and the Departure in the Eaſt Column. The like is to be underſtood of the reſt.

Having found the Difference of Latitude and Departure for all your ſeveral Courſes, and inſerted them in their proper Columns, you muſt then add up your *North*, *South*, *Eaſt* and *Weſt* Columns, and ſubtract the North and South Columns the one from the other, *viz.* the leſſer from the greater; and likewiſe the Eaſt and Weſt Columns. So in the Table, the Sum of the North Column is 35.2, of the South Column 122.4, of the Eaſt Column 37.4, and of the Weſt Column, 156.7; ſubtracting the North Column from the South, the Remainder is 87.2, the Difference of Latitude Southerly; and ſubtract the Eaſt Column from the Weſt, the Remainder is 119.3, the Departure Weſterly.

Having the Difference of Latitude and Departure, you may find the Courſe and Diſtance by *Prob.* 6. But in this Example, becauſe your Difference of Latitude 87.2, and your Departure 119.3, out-run the Table, that is to ſay, you can find no ſuch Numbers in the Table, therefore take the half of your Difference of Latitude, which is 43.6, and the half of your Departure, which is 59.6. According to the Direction in the ſixth *Problem*, over 4 $\frac{3}{4}$ Points, againſt 44.1, in the Column of Latitude, you will find 59.4 in the Column of Departure, (which are the two neareſt Numbers in the Table) and in the Column of the Diſtance 74, which being doubled, is 148, the Diſtance ſought. The Courſe is between the South and the Weſt, becauſe the Difference of Latitude is Southerly, and the Departure Weſterly, therefore the Courſe is South Weſt $\frac{3}{4}$ Weſt, which was required.

This Table in particular is very uſeful for the eaſy forming of a Sea-Reckoning or Journal, as ſhall be inſtanced in this following Table, being a Journal from the *Lizard* to the *Barbadoes.*

The Title of your Journal may be as follows.

A Journal of our Voyage, intended, by God's Permiſſion, from the Lizard, *in the Latitude* 50 deg. 00 min. *North, Longitude (from the* Pike *of* Teneriff) 12 deg. 37 min. *to the Iſland of* Barbadoes, *in the Latitude* 13 deg. 12 min. *N. Longitude* 319 deg. 40 min. *The Difference of Longitude between the* Lizard *and the* Barbadoes *is* 52 deg. 57 min. *the Courſe S.W.* $\frac{1}{2}$ *Diſtance* 2821 min. March 22d, 1694. *The* Lizard *bears North, diſtant* 30 min.

Days.	Month & Latit. by Obſervat.	The Courſe Corrected.	Diſt. in min.	North.	South-ing min.	Eaſt-ing min.	Weſt-ing min.	Lat. by reckon. D. M.	Eaſt Diff. min.	Weſt Longit. min.
22	*March.*	*Lizard* South.	30		30.0	—	—	49.30	—	—
23		South-Weſt.	112		79.2	—	79.2	48.11	—	120.0
24	47° 00′	S.W.by S.½W.	72		55.6		45.7	47.15		68.1
		Correction by Obſervat.			15.0	—	11.0	47.00	—	16.0
25		S.W. by South.	96	—	79.8	—	53.3	45.40	—	75.2
26		S.W.by South.	79	—	65.7	—	43.9	44.34	—	62.8
27	42 37	S.W.by South.	138	—	114.6	—	76.7	42.39	—	106.2
28		S.S.W.¾W.	129	—	110.7	—	66.3	40.48	—	88.8
29		S.S.W.	72	—	66.5	—	27.6	39.41	—	36.4
30	37 44	S.S.W.½W.	102		90.0		48.0	38.11		62.0
		Correction by Obſervat.			27.0	—	16.0	37.44	—	20.0
1	*April.*	South-Weſt.	85	—	60.1	—	60.1	36.44	—	75.0
2		W.S.W.	20	—	7.6	—	18.5	36.36	—	24.1
3		S. by W.½W.	32	—	30.6	—	9.3	36.05	—	11.9
4	34 10	South by Weſt.	120		117.7		23.4	34.07		27.9
		Correct. by Obſerv.		3.0		1.0		34.10	1.0	
5		S. by W.½W.	164	—	156.9	—	47.6	31.33	—	56.7
6	29 37	S.S.W.	125	—	115.5	—	47.9	29.37	—	55.9
7		S.W.by South.	110	—	91.4	—	61.2	28.06	—	69.5
8		S.W.by South.	122	—	101.4	—	67.8	26.25	—	76.2
9	24 43	South-Weſt.	116		82.0		82.0	25.03		91.0
		Correction by Obſervat.			20.0	—	11.0	24.43	—	12.0
10		South-Weſt.	97	—	68.6	—	68.6	23.34	—	75.0
11		South-Weſt.	96	—	67.9	—	67.9	22.26	—	74.0
12		South-Weſt.	114	—	80.6	—	80.6	21.05	—	88.0
13		South-Weſt.	118	—	83.5	—	83.5	19.41	—	89.0
14		S.W.by Weſt.	110	—	61.2	—	91.4	18.40	—	96.2
15		W.S.W.	91		34.8		84.1	18.05		89.4

Days.	Month & Latit. by Obſervat.	The Courſe Corrected.	Diſt. in min.	North.	South-ing. min.	Eaſt-ing. min.	Weſt-ing. min.	Lat. by reckon. D. M.	Eaſt Diff. min.	Weſt Long. min.
	1694.		*Brought from the other ſide*					18.05	1.0	1667.3
16	*April.*	W. S. W.	91		34.8		84.1	17.30		87.0
17		W. S. W.	84		32.1		77.6	16.58		82.0
18		W. S. W.	1[illegible]		41.0		98.9	16.17		103.7
19		W. S. W.	103		39.5		95.2	15.37		99.0
20	14 43	W. S. W.	110		44.4		107.2	14.53		111.0
		Correction by Obſervat.			10.0		15.9	14.43		16.0
21		W. by S.	110		21.5		107.9	14.21		114.1
22		W. by S.	120		23.4		117.7	13.58		119.1
23		W. by S.	106		20.7		104.0	13.37		108.7
24		W. by S.	100		19.5		98.1	13.17		103.8
25		W by S.	120		23.4		117.7	12.54		118.7
26	13° 12′	W. by N.	100	19.5			98.1	13.14		103.1
27		Weſt.	130				130.0	13.12		133.5
28		Weſt.	136				136.0	13.12		139.0
29	13° 12′	Weſt.	69				69.0	13.12		70.8

The whole Difference of Longitude is 3177.6, or 3178 *min.* which is 52° 58′ Weſterly.

The Explanation of this Journal.

In this *Journal* there are eleven Columns; The firſt contains the *Days of the Month*; the ſecond the *Month of the Year*, and *Latitude by Obſervation*; the third, the *Courſe corrected*, by the allowance for *Lee-way*, or for the *Variation of the Compaſs*, if there be any; the fourth, the *Diſtance ſailed*; the fifth, ſixth, ſeventh, and eighth, the *Northing*, *Southing*, *Eaſting*, and *Weſting*, being the Difference of Latitude and Departure of the ſeveral Courſes and Diſtances; the ninth, the *Latitude* by *Dead-Reckoning*; the tenth, the *Eaſt Diff. Longitude*; the eleventh, the *Weſt Diff. Longitude.*

Here I would adviſe all that are deſirous to give a good account of their Reckoning to any that have Reaſon or Authority to demand it, That they keep a particular Account of that which they take off the Log-board every Day at Noon, either in the ſame Book where they keep their Reckoning, or elſe in a Book diſtinctly for that purpoſe, commonly called a *Log-Book.*

Now the manner of proceeding in this Journal, by the help of the Table of Latitude and Departure, is very facile, as follows: The 22*d* of *March* at Noon, I find the ***Lizard*** to bear North, and to be diſtant about 10 Leagues, or 30 Miles or Minutes; therefore I am to the Southward of the *Lizard* 30', which 30' I place in the South Column, and that makes my Latitude 49° 30'.

The 23*d* day my Courſe is South-Weſt, and the Diſtance 112', to find the Difference of Latitude and Departure by the Table of Latitude and Departure, according to *Prob.* 1. The Difference of Latitude is 79.2, and the Departure 79.2: Becauſe the Courſe is South-Weſterly, I place the Difference of Latitude in the South Column, and my Departure in the Weſt Column; 79', or 1° 19' ſubtracted from 40° 30', gives the Latitude 48° 11'.

How to find the Difference of Longitude.

To find the Difference of Longitude in the two laſt Columns, you have both Latitudes, 48° 11', and 49° 30', (the preſent Latitude, and the Latitude of the Day before) and the Courſe S. W. by which you may find the Diff. Longitude, according to the Proportion in *Cap.* 6. *Prob.* 3. of *Mercator's Sailing*; ſaying, *As Radius to the Meridional Diff. Latitude; So is the Tang. of the Courſe to the Diff. Long.* This Proportion being wrought by the Logarithms, or *Gunter's Scale*, (which may ſerve in this caſe) you will find the Diff. Longitude 120', which place in the Weſt Column, becauſe your Courſe is Weſterly.

The 24*th* day is wrought after the manner of the 23*d*, having the Courſe and Diſtance given, to find the Diff. Latitude, Departure, and Diff. Longitude, as was ſhewed before.

How to correct your Reckoning by Obſervation of the Latitude.

On the 24*th* of *March*, by a good Obſervation, I find my Latitude to be 47°, whereas by my reckoning I ſhould be in the Lat. 47° 15', 15′, ſo that the Difference is 15′ more Southerly: Therefore to correct my Latitude, I place 15′ in the South Column, which ſubtracted from 47° 15′, makes my Latitude by Reckoning to agree with the Obſervation. To correct your Departure, you muſt conſider, whether the Fault may be imputed to your Courſe, or to your Diſtance: If your Courſe be well ſteered, and you find no Current, nor any Variation of the Compaſs, then your Diſtance is faulty; but if you cannot truſt to the Courſe ſteered, then your beſt way is to correct your Latitude only, not medling with your Departure. If there be a Current, and you know which way the Current ſets, and how faſt, then find the Diff. Lat. and Departure of the Current, and add or ſubtract that Latitude and Departure to or from the Ship's Diff. Lat. and Departure, according as the Current doth further or hinder your Ship in her Courſe. But if you only by ſome probable reaſon conjecture there is a Current, then give what allowance you think meet in Diff. Lat. and Departure, and ſee if that will reform your Reckoning in your Lat. If ſo, you have gueſſed well; but if it will not, it is to be ſuppoſed that you are miſtaken in your Conjecture, or that there is ſome other Cauſe of this Error in your Reckoning.

53.30 / 31
53.3 / 2

If the Compaſs varies (as moſt commonly it doth) then finding what the Variation is, and which way it is, you muſt allow it in the Ship's Courſe. But if you cannot impute the Error to any of theſe, then (as I ſaid before) the Diſtance is faulty; and this is that which uſually makes the Difference between the Lat. obſerved, and the Lat. by your Reckoning: And this I take to be the Cauſe of the Error this 24*th* day of *March*, and generally in this Reckoning.

Now to correct your Departure and Diff. Longitude, you muſt add up the *North*, *South*, *Eaſt* and *Weſt-Columns*, from the Day that you correct, to the beginning of your *Journal-Tables*: If it be the firſt Correction you have made, or from the day of Correction to the laſt Correction; if it be the ſecond, third, fourth Correction, &c. then ſubtract the Sums of the North and South Columns from each other, and likewiſe of the Eaſt and Weſt, and ſay by the Rule of Proportion: As the Diff. of the *North* and *South* Columns, to the Diff. of the *Eaſt* and *Weſt* Columns; ſo is the Difference between the Latitudes by Obſervation and Reckoning, to the Diff. in the Departure. And for the Diff. Longit. As the Diff. between the Latitudes by Obſervation and Reckoning, to the Meridional Difference for thoſe two Latitudes; ſo is the Diff. in the Departure, to the Diff. in the Longitude.

Example.

The 24*th* day you will find the Sum of the North Column 00, the Sum of the South Column (leaving out 15′, the Error) 164.8 min. and therefore their Diff. is 164.8. The Sum of the Eaſt Column is 00 min. of the Weſt Column 124.9. and their Diff. 124.9. Then the Operation by the *Logarithm* will be,

		Co. Ar.
As the Diff. of the North and South Columns,	164.8	7.78304
To the Diff. of the Eaſt and Weſt Columns, ——	124.9	2.09656
So is the Diff. between the two Latitudes, ——-	15.0	1.17609
To the Difference in the Departure, ———	11	~~1~~1.05569

Place this 11 min. in the Weſt Column, becauſe the Sum of the Weſt Column exceeds the Sum of the Eaſt Column.

In this Operation we neglect the Tenths of the Departure, as not to be regarded.

The Operation for the Difference in the Longitude.

The two Latitudes are 47 deg. 15 min. and 47 deg. 00 min. by which in the Table of *Meridional Parts* you will find the Merid. Diff. Lat. 22 min. Therefore,

		Co. Ar.
As the Diff. between the two Latitudes,	15′	8.82391
To the Merid. Diff. of thoſe Lat. ——	22	1.34242
So is the Diff. in the Departure, ——	11	1.04139
To the Diff. in the Longitude, ——	16	~~1~~1.20772

This 16′ is placed in the Weſt Column, becauſe the Departure is Weſterly.

After the ſame manner are the Corrections made in this Journal, on the 30*th* of *March*, the 4*th*, the 9*th*, and the 20*th* days of *April*; the Error being ſuppoſed to be in the eſtimate Diſtance.

If your Ship ſail ſeveral Courſes in 24 hours, you muſt find your Diff. Latitude and Departure, by working a Traverſe, according to *Prob.* 7. in the Uſe of the Table of Latitude and Departure; your Diff. Lat. will give you what Latitude the Ship is in, then have you two Latitudes, *viz.*

the Lat. the Ship was in the Day before at Noon, and the Lat. the Ship is now in, by which you may find the Meridional Diff. Lat. by the Table of Meridional Parts, according to *Chap. 6. Prob. 1.* of *Mercator's* Sailing.

Then for your Diff. Longitude, ſay,

As the Diff. Latitude found by the Traverſe,
To the Diff. Latitude in Meridional Parts:
So is the Departure found by the Traverſe,
To the Diff. Longitude for that Traverſe.

To find the whole Diff. Longitude of the two Ports between which you make your Voyage.

Add up the Columns of Eaſt and Weſt Diff. of Longitude, and ſubtract the one from the other, the Remainder reduced into degrees and minutes, is the Diff. Longitude ſought.

In this Journal, the Diff. of the Eaſt and Weſt Columns of Longitude is 3177.6, or 3178′, which reduced into Degrees and Minutes, makes 52° 58′, the Diff. Long. between the *Lizard* and the *Barbadoes.*

The Uſe of the Table of ten Chiliads, or ten thouſand Logarithms.

1. ANy *Number given under* 10000; *To find the Logarithm thereof.* The left-hand Column of every Page contains Numbers increaſing in their natural Order from 1 to 999 The other five Columns of each Page contain the Logarithms of all Numbers, from 1 to 9999. Theſe Columns on the left-hand Page are diſtinguiſhed with the Figures, 0, 1, 2, 3, 4; thoſe on the Right-hand Page, with 5, 6, 7, 8, 9.

The Numbers in the left-hand Column, by the ſupply of thoſe Figures on the top of the other Columns, do extend to 9999, and are to be read croſs both Pages.

If the Number propounded to find its Logarithm conſiſt of one Place; as ſuppoſe you were to find the Logarithm of (7), look for (7) among the Figures on the top of the Columns, and right againſt (0) in the left-hand Column, and under (7) you will find 0.8450980, which is the Log. of 7.

If the Number propounded conſiſt of two Places, as (68); look the firſt Figure (6) in the left-hand Column, and the laſt Figure (8) at the top of the Page; then right againſt (6) and under (8) you will find 1.8325089, which is the Log. of 68.

If the Number conſiſt of three Places, as 574, look for the two firſt Figures (57) in the left hand Column, and the laſt Figure (4) at the top of the Page; then right againſt (57) and under (4) you will find 2.5789119, which is the Log. of 574.

If the Number conſiſt of four Places, as 9499, look the three firſt Figures (949) in the left-hand Column, and the laſt Figure (9) at the top of the Page; ſo right againſt (949) and under (9) you will find 3.9776779, which is the Log. of 9499.

2. *A Log. being given, to find the correſpondent Number:*

Note; If the firſt Figure of the given Log. be (0), the Number ſought conſiſts of one Place; if it be (1), it conſiſts of two Places; if it be (2), of three Places; if it be (3), of four Places.

Let the Log. be 0.9030900; this Log. will be found in the firſt Line of the Table againſt (0); for if you look in the firſt Line, croſſing both Pages, under (8) upon the right-hand Page, you will find the given Log. which ſhews that (8) is the Number ſought.

Let the Log. be 1.9190781; look down the ſecond Column of the left-hand Page, among thoſe Log's, and you will find the neareſt, being leſs than the given Log. to be 1.9030900, and the Number againſt it in the left-hand Column is (8); then look croſs the Pages in the ſame Line againſt (8), and under (3) at the top of the Page, you will find the Log. given, therefore the Number ſought is 83.

Let the Log. be 2.8318691; look down the ſecond Column of the left-hand Page, until you find a Log. being the neareſt leſs than the given Log. which will be 2.8260748, and the Number againſt it in the left-hand Column, is 67; then look croſs both Pages in the ſame Line againſt 67, and under 9 (at the top of the Page) you will find the given Log. therefore the Number ſought is 679.

Let 3.9802761 *be the Log. given*; look down the ſecond Column as before, and you will find the neareſt leſs to be 3.9800034, and the Number againſt it 955; and croſſing the Pages, as before directed, under (6) you will have the given Log. Therefore the Number ſought is 9556.

Let the Log. given be 3.9664379; If you look in the Table, according to the former Directions, you cannot find any Log. the ſame with this here given; and this is commonly the Caſe in the uſe of theſe Tables; but then you muſt find the neareſt, being leſs than the Log. given, which is 3.9664233, and the Number anſwering thereto is 9256, which is the neareſt in whole Numbers.

The Uſe of the Table of Artificial, or Logarithmical Sines, Tangents, & Secants.

THis Table contains the *Logarithmical Sines*, *Tangents* and *Secants*, *of every Degree and Minute of the Quadrant.*

1. *To find the Sine, Tangent, or Secant of any Degree and Minute.*

If the Degree be leſs than 45, your Sine, Tangent, or Secant, is found in thoſe Columns which are diſtinguiſhed with the words, (*Sine*) (*Tang.*) (*Secant*) at the head of the Table.

But if the Degrees exceed 45, then your Sine, Tangent, or Secant, is found in thoſe Columns, which are diſtinguiſhed by the words, (*Sine*) (*Tang.*) (*Secant*) at the foot of the Table.

Suppoſe you were to find the Log. Sine, Tangent, or Secant of 32° 12′; Look for 32° at the Head of the Table, and upon the left-hand Page, in the Column of Minutes, under the Letter (M), you will find 12′, and againſt 12′, and under *Sine* at the Head of the Table, you ſhall find 9.7266264, which is the *Log. Sine* of 32° 12′; and againſt 12′, and under (*Tang.*) you have 9.7991569, the *Log. Tang.* of 32° 12′; and againſt 12′, and under (*Secant*) you have 10.0725305, the *Log. Secant* of 32° 12′.

Suppoſe you were to find the Log. Sine, Tangent or Secant of 37° 47′: Look for 37 deg. at the head of the Table, and upon the right-hand Page (becauſe the Minutes exceed 30) in the Column of Min. under (M), you muſt look for 47 min. and againſt 47 min. and under (*Sine*) at the head of the Table, you will find 9.7872317, the Sine of 37 deg. 47 min. And againſt 47, and under (*Tang.*) you will find 9.8894214, the Tang. of 37 deg. 47 min. And againſt 47, and under (*Secant*) you will find 10.1021897, the Secant of 37 deg. 47 min.

Suppoſe you were to find the Log. Sine, Tangent, or Secant of 64° 15′: Turn to 64° at the foot of the Table, and upon the right-hand Page, in the Column of Minutes, over the Letter (M) look upwards for 15′; againſt 15′, and over (*Sine*) at the foot of the Table, you will find 9.9545793, the Sine of 64° 15′; and againſt 15′, and over (*Tang.*) you will find 10.3166443, the *Tangent* of 64° 15′. And againſt 15′, and over (*Secant*) you will find 10.3620649, the *Secant* of 64° 15′.

Suppoſe you were to find the Log. Sine, Tangent, or Secant of 78° 45′: Turn to 78° at the foot of the Table, and upon the left-hand Page, (becauſe the Minutes exceed 30) in the Column of Minutes, over (M), look for 45; againſt 45, and over (*Sine*) you find the Sine of 78° 45′ to be 9.9915739, and the Tangent, in the ſame Line over (*Tang.*) to be 10.7013382; and the *Secant* over (*Secant*) to be 10.7097643.

2. *A Log. Sine, Tangent, or Secant being given; to find the Degrees and Minutes anſwering thereto.*

This is but the Converſe of the former; but that you may the more readily turn to the deg. and min. required, take this brief Direction.

If it be a Sine, and the five firſt Figures be leſs than 9.8494, or a Tangent leſs than *Radius*, or 10.0000000; or a Secant, and the ſix firſt Figures leſs than 10.1505; then it is a Sine, Tangent, or Secant of leſs than 45°, and is to be ſought in thoſe Columns diſtinguiſhed with (*Sine*) (*Tang.*) (*Secant*) at the Head of the Table; but if the *Sine*, *Tangent*, or *Secant*, exceed theſe reſpective Numbers, then the Degrees anſwering thereto are more than 45, and they are to be found in thoſe Columns diſtinguiſhed by (*Sine*) (*Tang.*) (*Secant*) at the Foot of the Table.

Suppoſe you were to find the Degree and Minute correſponding to this Sine 9.7035329: This being leſs than 45, I run over the Columns of Sines diſtinguiſhed by (*Sine*) at the top, and under 30°, and againſt 21′, I find the given Sine.

Suppoſe I were to find the Degree and Minute correſponding to this Tangent 10.3862931: This being greater than 45°, I run over the Columns of *Tangents*, diſtinguiſhed by (*Tang.*) at the foot of the Table, and over 67°, and againſt 39′, I find the neareſt leſs, *viz.* 10.3860000, and therefore the deg. and min. correſponding are 67° 39′.

1. *Note*; If you are to find the *Sine-Complement*, *Tangent Complement*, or *Secant-Complement* of any Degree and Minute; as ſuppoſe you were to find the Sine-Complement of 39° 17′, ſubtract 39° 17′ from 90° 00′, and look the Sine of the Remainder, (or Complement to 90°) *viz.* the Sine of 50° 43′.

2. *Note*; If you are to find the Sine, Tangent, or Secant of any Number of Degrees and Minutes exceeding 90; as ſuppoſe you were to find the Tangent of 127° 39′, ſubtract 127° 39′ from 180° 00′, and find the Tangent of the Remainder, *viz.* the Tangent 52° 21′, which is alſo the Tangent 127° 39′, as was required.

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A
TABLE
CONTAINING
Ten Chiliads
OF
LOGARITHMS:
FOR
Numbers increaſing in their Natural
Order, from 1 to 10000.

LONDON;
Printed by *John Darby*, for *John Seller* and
Richard Mount, 1694.

Num.	0	1	2	3	4
0	0.0000000	0.0000000	0.3010300	0.3771212	0.6020600
1	1.0000000	1.0413927	1.0791812	1.1139433	1.1461280
2	1.3010300	1.3222193	1.3424227	1.3617278	1.3802112
3	1.4771212	1.4913617	1.5051500	1.5185139	1.5314789
4	1.6000600	1.6127838	1.6232493	1.6334684	1.6434527
5	1.6989700	1.7075702	1.7160033	1.7242759	1.7323937
6	1.7781512	1.7853298	1.7923917	1.7993405	1.8061800
7	1.8450980	1.8512583	1.8573325	1.8633228	1.8692317
8	1.9030900	1.9084850	1.9138138	1.9190781	1.9242793
9	1.9542425	1.9590414	1.9637878	1.9684829	1.9731278
10	2.0000000	2.0043214	2.0086002	2.0128372	2.0170333
11	2.0413927	2.0453230	2.0492180	2.0530784	2.0569048
12	2.0791812	2.0827854	2.0863598	2.0899051	2.0934217
13	2.1139433	2.1172713	2.1205739	2.1238516	2.1271048
14	2.1461280	2.1492191	2.1522883	2.1553360	2.1583625
15	2.1760912	2.1789769	2.1818436	2.1846914	2.1875207
16	2.2041200	2.2068259	2.2095150	2.2121876	2.2148438
17	2.2304489	2.2329961	2.2355284	2.2380461	2.2405492
18	2.2552725	2.2576786	2.2600714	2.2624511	2.2648178
19	2.2787536	2.2810333	2.2833012	2.2855573	2.2878017
20	2.3010300	2.3031960	2.3053513	2.3074960	2.3096301
21	2.3222193	2.3242824	2.3263358	2.3283796	2.3304138
22	2.3424227	2.3443923	2.3463530	2.3483048	2.3502480
23	2.3617278	2.3636120	2.3654880	2.3673559	2.3692158
24	2.3802112	2.3820170	2.3838153	2.3856063	2.3873898
25	2.3979400	2.3996737	2.4014005	2.4031205	2.4048337
26	2.4149733	2.4166405	2.4183013	2.4199557	2.4216039
27	2.4313637	2.4329693	2.4345689	2.4361626	2.4377505
28	2.4471580	2.4487063	2.4502491	2.4517864	2.4533183
29	2.4623980	2.4638930	2.4653828	2.4668676	2.4683473
30	2.4771212	2.4785665	2.4800069	2.4814426	2.4828736
31	2.4913617	2.4927604	2.4941546	2.4955443	2.4969296
32	2.5051500	2.5065050	2.5078559	2.5092025	2.5105450
33	2.5185139	2.5198280	2.5211381	2.5224442	2.5237464
34	2.5314789	2.5327544	2.5340261	2.5352941	2.5365584
35	2.5440680	2.5453071	2.5465426	2.5477747	2.5490033
36	2.5563025	2.5575072	2.5587086	2.5599066	2.5611014

Num.	5	6	7	8	9
0	0.6989700	0.7781512	0.8450980	0.9030900	0.9542425
1	1.1760912	1.2041200	1.2304489	1.2552725	1.2787536
2	1.3979400	1.4149733	1.4313637	1.4471580	1.4623980
3	1.5440680	1.5563025	1.5682017	1.5797836	1.5910646
4	1.6532125	1.6627578	1.6720978	1.6812412	1.6901961
5	1.7403627	1.7481880	1.7558748	1.6734280	1.7708520
6	1.8129133	1.8195439	1.8260748	1.8325089	1.8388491
7	1.8750612	1.8808136	1.8864907	1.8920946	1.8976271
8	1.9294189	1.9344984	1.9395192	1.9444827	1.9493900
9	1.9777236	1.9822712	1.9867717	1.9912261	1.9956352
10	2.0211893	2.0253058	2.0293838	2.0334237	2.0374265
11	2.0606978	2.0644580	2.0681858	2.0718820	2.0755469
12	2.0969100	2.1003705	2.1038037	2.1072099	2.1105897
13	2.1303337	2.1335389	2.1367205	2.1398791	2.1430148
14	2.1613680	2.1643528	2.1673173	2.1702617	2.1731862
15	2.1903317	2.1931246	2.1958996	2.1986571	2.2013971
16	2.2174839	2.2201081	2.2227165	2.2253093	2.2278867
17	2.2430380	2.2455127	2.2479732	2.2504200	2.2528530
18	2.2671717	2.2695129	2.2718416	2.2741578	2.2764618
19	2.2900346	2.2922561	2.2944662	2.2966652	2.2988531
20	2.3117538	2.3138672	2.3159703	2.3180633	2.3201463
21	2.3324384	2.3344537	2.3364597	2.3384565	2.3404441
22	2.3521825	2.3541084	2.3560258	2.3579348	2.3598355
23	2.3710678	2.3729120	2.3747483	2.3765770	2.3783979
24	2.3891661	2.3909351	2.3926969	2.3944517	2.3961993
25	2.4065402	2.4082399	2.4099331	2.4116197	2.4132997
26	2.4232459	2.4248816	2.4265112	2.4281348	2.4297523
27	2.4393327	2.4409091	2.4424797	2.4440448	2.4456042
28	2.4548448	2.4563660	2.4578819	2.4593925	2.4608978
29	2.4698220	2.4712917	2.4727064	2.4742162	2.4756712
30	2.4842998	2.4857214	2.4871384	2.4885507	2.4899585
31	2.4983105	2.4996871	2.5010593	2.5024271	2.5037907
32	2.5118834	2.5132176	2.5145477	2.5158738	2.5171959
33	2.5250448	2.5263393	2.5276299	2.5289167	2.5301997
34	2.5378191	2.5390761	2.5403295	2.5415792	2.5428254
35	2.5502283	2.5514500	2.5526682	2.5538830	2.5550944
36	2.5622929	2.5634811	2.5646661	2.5658478	2.5670263

Num.	0	1	2	3	4
37	2.5682017	2.5693739	2.5705429	2.5717088	2.5728716
38	2.5797836	2.5809250	2.5820634	2.5831988	2.5843312
39	2.5910646	2.5921767	2.5932861	2.5943925	2.5954962
40	2.6020600	2.6031444	2.6042260	2.6053050	2.6063813
41	2.6127838	2.6138418	2.6148972	2.6159500	2.6170003
42	2.6232493	2.6242821	2.6253124	2.6263403	2.6273658
43	2.6334684	2.6344773	2.6354837	2.6364879	2.6374897
44	2.6434527	2.6444386	2.6445223	2.6464037	2.6473830
45	2.6532125	2.6541765	2.6541384	2.6560982	2.6570558
46	2.6627578	2.6637009	2.6646420	2.6655810	2.6665180
47	2.6720978	2.6730209	2.6739420	2.6748611	2.6757783
48	2.6812412	2.6821451	2 6830470	2.6839471	2.6848454
49	2.6901961	2.6910815	2.6919651	2.6928469	2.6937269
50	2.6989700	2.6998377	2.7007037	2.7015680	2.7024305
51	2.7075702	2.7084209	2.7092700	2.7101174	2.7109631
52	2.7160033	2.7168377	2.7176705	2.7185017	2.7193313
53	2.7242759	2.7250945	2.7259116	2.7267272	2.7275412
54	2.7323937	2.7331973	2.7339993	2.7347998	2.7355989
55	2.7403627	2.7411516	2.7419391	2.7427251	2.7435098
56	2.7481880	2.7489628	2.7497363	2.7505084	2.7512791
57	2.7558748	2.7566361	2.7573960	2.7581546	2.7589119
58	2.7634280	2.7641761	2.7649230	2.7656685	2.7664128
59	2.7708520	2.7715875	2.7723217	2.7730547	2.7737864
60	2.7781512	2.7788745	2.7795965	2.7803173	2.7810369
61	2.7853298	2.7860412	2.7867514	2.7874605	2.7881684
62	2.7923917	2.7930916	2.7937904	2.7944880	2.7951846
63	2.7993405	2.8000293	2.8007171	2.8014037	2.8020892
64	2.8061800	2.8068580	2.8075350	2.8082110	2.8088859
65	2.8129133	2.8135810	2.8142476	2.8149132	2.8155777
66	2.8195439	2.8202014	2.8208580	2.8215135	2.8221681
67	2.8260748	2.8267225	2.8273693	2.8280151	2.8286599
68	2.8325089	2.8331471	2.8337844	2.8344207	2.8350561
69	2.8388491	2.8394780	2.8401061	2.8407332	2.8413595
70	2.8450080	2.8457180	2.8463371	2.8469553	2.8475726
71	2.8512583	2.8518696	2.8524800	2.8530895	2.8536982
72	2.8573325	2.8579353	2.8585372	2.8591383	2.8597387
73	2.8633229	2.8639174	2.8645111	2.8651040	2.8656960

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37	2.5740313	2.5751878	2.5763413	2.5774918	2.5786392
38	2.5854607	2.5865873	2.5877110	2.5888317	2.5899496
39	2.5965971	2.5976952	2.5987905	2.5998831	2.6009729
40	2.6074550	2.6085260	2.6095944	2.6106602	2.6117233
41	2.6180481	2.6190933	2.6201360	2.6211763	2.6222140
42	2.6283889	2.6294096	2.6304279	2.6314438	2.6324573
43	2.6384892	2.6394865	2.6404814	2.6414741	2.6424645
44	2.6483600	2.6493348	2.6503075	2.6512780	2.6522463
45	2.6580114	2.6589648	2.6599162	2.6608655	2.6618127
46	2.6674529	2.6683859	2.6693169	2.6702458	2.6711728
47	2.6766936	2.6776069	2.6785184	2.6794279	2.6803355
48	2.6857417	2.6866362	2.6875290	2.6884198	2.6893088
49	2.6946052	2.6954817	2.6963564	2.6972293	2.6981005
50	2.7032914	2.7041505	2.7050079	2.7058637	2.7067178
51	2.7118072	2.7126497	2.7134905	2.7143297	2.7151673
52	2.7201593	2.7209857	2.7218106	2.7226339	2.7234557
53	2.7283538	2.7291648	2.7299743	2.7307822	2.7315888
54	2.7363965	2.7371926	2.7379873	2.7387805	2.7395723
55	2.7442930	2.7450748	2.7458552	2.7466342	2.7474118
56	2.7250484	2.7528164	2.7535830	2.7543483	2.7551123
57	2.7956678	2.7604225	2.7611758	2.7619278	2.7626786
58	2.7761558	2.7678976	2.7686381	2.7693773	2.7701153
59	2.7475170	2.7752462	2.7759743	2.7767012	2.7774268
60	2.7187554	2.7824726	2.7831887	2.7839036	2.7846173
61	2.7888751	2.7895807	2.7902852	2.7909885	2.7916906
62	2.7958800	2.7965743	2.7972675	2.7979596	2.7986506
63	2.8027737	2.8034571	2.8041394	2.8048206	2.8055008
64	2.8095597	2.8102325	2.8109043	2.8115750	2.8122447
65	2.8162413	2.8169038	2.8175654	2.8182259	2.8188854
66	2.8228216	2.8234742	2.8241258	2.8247765	2.8254261
67	2.8293038	2.8299467	2.8305887	2.8312297	2.8318698
68	2.8356906	2.8363241	2.8369567	2.8375884	2.8382192
69	2.8419848	2.8426092	2.8432328	2.8438554	2.8444772
70	2.8481891	2.8488047	2.8494194	2.8500332	2.8506462
71	2.8543060	2.8549134	2.8555191	2.8561244	2.8567289
72	2.8603380	2.8609366	2.8615344	2.8621314	2.8627275
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75	2.8750613	2.8756399	2.8762178	2.8767950	2.8773713
76	2.8808136	2.8813846	2.8819550	2.8825245	2.8830933
77	2.8864907	2.8870544	2.8876170	2.8881795	2.8887410
78	2.8920946	2.8926510	2.8932067	2.8937618	2.8943161
79	2.8976271	2.8981765	2.8987252	2.8992732	2.8998205
80	2.9030900	2.9036325	2.9041744	2.9047155	2.9052560
81	2.9084850	2.9090208	2.9095560	2.9100905	2.9106244
82	2.9138138	2.9143431	2.9148718	2.9153998	2.9159272
83	2.9190781	2.9196010	2.9201233	2.9206450	2.9211660
84	2.9242793	2.9247960	2.9253121	2.9258276	2.9263424
85	2.9294189	2.9299296	2 9304396	2.9309490	2.9314579
86	2.9344984	2.9350031	2.9355073	2.9360108	2.9365137
87	2.9395192	2.9400181	2.9405165	2.9410142	2.9415114
88	2.9444827	2.9449759	2.9454686	2.9459607	2.9464523
89	2.9493900	2.9498777	2.9503648	2.9508514	2.9513375
90	2.9542425	2.9547248	2.9552005	2.9556877	2.9561684
91	2.9590414	2.9595184	2.9599948	2.9604708	2.9609462
92	2.9637878	2.9642596	2.9647309	2.9652017	2.9656720
93	2.9684829	2.9689497	2.9694159	2.9698816	2.9703469
94	2.9731278	2.9735896	2.9740509	2.9745117	2.9749720
95	2.9777236	2.9781805	2.9786369	2.9790929	2 9795484
96	2.9822712	2.9827234	2.9831750	2.9836263	2.9840770
97	2.9867717	2.9872192	2.9876663	2 9881128	2.9885589
98	2.9912261	2.9916690	2.9921115	2.9925535	2.9929951
99	2.9956352	2.9960736	2.9965117	2.9969492	2.9973864
100	3.0000000	3.0004341	3.0008677	3.0013009	3.0017337
101	3.0043214	3.0047511	3.0051805	3.0056094	3.0060379
102	3.0086002	3.0090257	3.0094509	3.0098756	3.0102999
103	3.0128372	3.0132587	3.0136794	3.0141003	3.0145205
104	3.0170333	3.0174507	3.0178677	3.0182843	3.0187005
105	3.0221893	3.0216027	3.0220157	3.0224284	3.0228406
106	3.0253059	3.0257154	3.0261245	3.0265333	3.0269416
107	3.0293838	3.0297895	3.0301948	3.0305997	3.0310043
108	3.0334227	3.0338257	3.0342273	3.0346284	3.0350293
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110	3.0413927	3.0417873	3.0421816	3.0425755	3.0429691

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74	2.8721563	2.8727388	2.8733206	2.8739016	2.8744818
75	2.8779469	2.8785218	2.8790959	2.8796692	2.8802418
76	2.8836614	2.8842288	2.8847953	2.8853612	2.8859263
77	2.8893017	2.8898617	2.8904210	2.8909796	2.8915374
78	2.8948696	2.8954225	2.8959747	2.8965262	2.8970770
79	2.9003671	2.9009131	2.9014583	2.9020029	2.9025468
80	2.9057959	2.9063350	2.9068735	2.9074114	2.9079485
81	2.9111576	2.9116901	2.9122220	2.9127533	2.9132839
82	2.9164539	2.9169800	2.9175055	2.9180303	2.9185545
83	2.9216865	2.9222063	2.9227254	2.9232440	2.9237620
84	2.9268567	2.9273704	2.9278834	2.9283958	2.9289077
85	2.9319661	2.9324738	2.9329808	2.9334873	2.9339932
86	2.9370161	2.9375179	2.9380191	2.9385197	2.9390198
87	2.9420080	2.9425041	2.9429996	2.9434945	2.9439889
88	2.9469433	2.9474337	2.9479236	2.9484130	2.9489018
89	2.9518230	2.9523080	2.9527924	2.9532763	2.9537597
90	2.9566486	2.9571287	2.9576073	2.9580858	2.9585639
91	2.9614211	2.9618955	2.9623693	2.9628427	2.9633155
92	2.9661417	2.9666110	2.9670797	2.9675480	2.9680157
93	2.9708116	2.9712758	2.9717396	2.9722028	2.9726656
94	2.9754318	2.9758911	2.9763500	2.9768083	2.9772662
95	2.9800034	2.9804579	2.9809119	2.9813655	2.9818186
96	2.9845273	2.9849771	2.9854265	2.9858753	2.9863238
97	2.9890046	2.9894498	2.9898946	2.9903388	2.9907827
98	2.9934362	2.9938769	2.9943171	2.9947569	2.9951963
99	2.9978231	2.9982593	2.9986951	2.9991305	2.9995655
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101	3.0064660	3.0068937	3.0073209	3.0077478	3.0081742
102	3.0107239	3.0111473	3.0115704	3.0119931	3.0124154
103	3.0149403	3.0153597	3.0157787	3.0161973	3.0166155
104	3.0191163	3.0195317	3.0199467	3.0203613	3.0207755
105	3.0232524	3.0236639	3.0240750	3.0244857	3.0248960
106	3.0273496	3.0277572	3.0281644	3.0285712	3.0289777
107	3.0314085	3.0318123	3.0322157	3.0326188	3.0330214
108	3.0354297	3.0358298	3.0362295	3.0366289	3.0370279
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110	3.0433623	3.0437551	3.0441476	3.0445398	3.0449315

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112	3.0492180	3.0496056	3.0499928	3.0503797	3.0507663
113	3.0530784	3.0534626	3.0538464	3.0542299	3.0546130
114	3.0569048	3.0572856	3.0576661	3.0580462	3.0584260
115	3.0606978	3.0610753	3.0614525	3.0618293	3.0622058
116	3.0644580	3.0648322	3.0652061	3.0655797	3.0659530
117	3.0681859	3.0685569	3.0689276	3.0692980	3.0696681
118	3.0718820	3.0722499	3.0726175	3.0729847	3.0733517
119	3.0755470	3.0759118	3.0762762	3.0766404	3.0770043
120	3.0791812	3.0795430	3.0799045	3.0802656	3.0806265
121	3.0827854	3.0831441	3.0835026	3.0838608	3.0842187
122	3.0863598	3.0867157	3.0870712	3.0874264	3.0877814
123	3.0899051	3.0902580	3.0906107	3.0909631	3.0913151
124	3.0934217	3.0937718	3.0941216	3.0944711	3.0948204
125	3.0969100	3.0972573	3.0976043	3.0979511	3.0982975
126	3.1003705	3.1007151	3.1010593	3.1014033	3.1017471
127	3.1038037	3.1041455	3.1044871	3.1048284	3.1051694
128	3.1072100	3.1075491	3.1078880	3.1082266	3.1085650
129	3.1105897	3.1109262	3.1112625	3.1115985	3.1119343
130	3.1139433	3.1142773	3.1146110	3.1149444	3.1152776
131	3.1172713	3.1176027	3.1179338	3.1172647	3.1185954
132	3.1205739	3.1209023	3.1212314	3.1215598	3.1218880
133	3.1238516	3.1241780	3.1245042	3.1248301	3.1251558
134	3.1271048	3.1274288	3.1277525	3.1280760	3.1283993
135	3.1303338	3.1306553	3.1309767	3.1312978	3.1316177
136	3.1335389	3.1338581	3.1341771	3.1344958	3.1348144
137	3.1367206	3.1370374	3.1373541	3.1376705	3.1379867
138	3.1398791	3.1401937	3.1405080	3.1408222	3.1411361
139	3.1430148	3.1433271	3.1436392	3.1439511	3.1442628
140	3.1461280	3.1464381	3.1467480	3.1470577	3.1473671
141	3.1492191	3.1495270	3.1498347	3.1501422	3.1504494
142	3.1522883	3.1525941	3.1528996	3.1532049	3.1535100
143	3.1553360	3.1556396	3.1559430	3.1562462	3.1565491
144	3.1583625	3.1586640	3.1589653	3.1592663	3.1595672
145	3.1613680	3.1616674	3.1619666	3.1622656	3.1625644
146	3.1643528	3.1646502	3.1649474	3.1652443	3.1655411
147	3.1673173	3.1676127	3.1679078	3.1682027	3.1684975

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112	3.0511525	.0515384	.0519239	.0523091	.0526939
113	3.0549958	.0553783	.0557605	.0561423	.0565237
114	3.0588055	.0591846	.0595634	.05994[illegible]9	.0603200
115	3.0625820	.0629578	.0633333	.0637[illegible]5	.0640834
116	3.6663259	.0666985	.0670708	.0674428	.0678145
117	3.0700379	3.0704073	3.0707765	3.0711453	3.0715138
118	3.0737183	.0740847	.0744507	.0748164	.0751818
119	3.0773679	.0777312	.0780941	.0784568	.0788192
120	3.0809870	.0813473	.0817073	.0820669	.0824263
121	3.0845763	.0839336	.0852906	.0856473	.0860037
122	3.0881361	.0884905	.0888446	.0891984	.0895519
123	3.0916669	3.0920185	3.0923696	3.0927206	3.0930712
124	3.0951693	.0955180	.0958664	.0962146	.0965624
125	3.0986437	.0989896	.0993353	.0996806	.1000257
126	3.1020905	.1024337	.1027766	.1031192	.1034616
127	3.1055102	.1058506	.1061909	.1065308	.1068705
128	3.1089031	.1092410	.1095785	.1099159	.1102529
129	3.1122698	3.1126050	3.1129400	3.1132746	3.1136091
130	3.1156105	.1159432	.1162756	.1166077	.1169336
131	3.1189257	.1192559	.1195858	.1199154	.1202448
132	3.1222159	.1225435	.1228709	.1231981	.1235250
133	3.1254813	.1258064	.1261314	.1264561	.1267806
134	3.1287223	.1290450	.1293676	.1296899	.1300119
135	3.1319393	3.1322597	3.1325798	3.1328998	3.1332194
136	3.1351326	.1354507	.1357685	.1360861	.1364034
137	3.1383027	.1386184	.1389334	.1392492	.1395643
138	3.1414498	.1417632	.1420765	.1423895	.1427022
139	3.1445742	.1448854	.1451964	.1455072	.1458177
140	3.1476763	.1479853	.1482941	.1486026	.1489110
141	3.1507564	3.1510632	3.1513698	3.1516762	3.1519824
142	3.1538149	.1541195	.1544240	.1547282	.1550322
143	3.1568519	.1571544	.1574568	.1577589	.1580608
144	3.1598678	.1601683	.1604685	.1607686	.1610684
145	3.1628630	.1631614	.1634595	.1637575	.1640553
146	3.1658376	.1661340	.1664301	.1667260	.1670218
147	3.1687920	.1690863	.1693805	.1696744	.1709682

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148	3.1702617	3.1705550	3.1708482	3.1711411	3.1714339
149	3.1731863	3.1734776	3.1737688	3.1740598	3.1743506
150	3.1760913	3.1763807	3.1766699	3.1769590	3.1772478
151	3.1789769	3.1792645	3.1795508	3.1798389	3.1801259
152	3.1818436	3.1821292	3.1824146	3.1826999	3.1829850
153	3.1846914	3.1849752	3.1852588	3.1855421	3.1858253
154	3.1875207	3.1878026	3.1880844	3.1883659	3.1886473
155	3.1903317	3.1906118	3.1908917	3.1911714	3.1914510
156	3.1931246	3.1934029	3.1936810	3.1939590	3.1942367
157	3.1958996	3.1961762	3.1964525	3.1967287	3.1970047
158	3.1986571	3.1989319	3.1992065	3.1994809	3.1997552
159	3.2013971	3.2016702	3.2019431	3.2022158	3.2024883
160	3.2041200	3.2043913	3.2046625	3.2049335	3.2052044
161	3.2068259	3.2070955	3.2073650	3.2076344	3.2079035
162	3.2095150	3.2097830	3.2100508	3.2103185	3.2105860
163	3.2121876	3.2124540	3.2127201	3.2129862	3.2132521
164	3.2148438	3.2151086	3.2153732	3.2156376	3.2159018
165	3.2174839	3.2177471	3.2180100	3.2186728	3.2185355
166	3.2201081	3.2203696	3.2206310	3.2208922	3.2211533
167	3.2227165	3.2229764	3.2232363	3.2234959	3.2237554
168	3.2253093	3.2255677	3.2258260	3.2260841	3.2263421
169	3.2278867	3.2281436	3.2284003	3.2286570	3.2289134
170	3.2304489	3.2307043	3.2309596	3.2312146	3.2314696
171	3.2329961	3.2332500	3.2335038	3.2337574	3.2340108
172	3.2355284	3.2357809	3.2360331	3.2362853	3.2365373
173	3.2380461	3.2382971	3.2385479	3.2387986	3.2390491
174	3.2405492	3.2407988	3.2410481	3.2412974	3.2415465
175	3.2430380	3.2432861	3.2435341	3.2437819	3.2440296
176	3.2455127	3.2457593	3.2460059	3.2462523	3.2464986
177	3.2479733	3.2482186	3.2484637	3.2487087	3.2489536
178	3.2504200	3.2506639	3.2509077	3.2511513	3.2513948
179	3.2528530	3.2530956	3.2533380	3.2535803	3.2538224
180	3.2552725	3.2555137	3.2557548	3.2559957	3.2562365
181	3.2576786	3.2579184	3.2581582	3.2583978	3.2586373
182	3.2600714	3.2603099	3.2605484	3.2607867	3.2610248
183	3.2624511	3.2626883	3.2629255	3.2631625	3.2633993
184	3.2648178	3.2650538	3.2652896	3.2655253	3.2657609

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148	3.1717264	3.1720188	3.1723110	3.1726029	3.1728947
149	3.1746412	3.1749316	3.1752218	3.1755118	3.1758016
150	3.1775365	3.1778250	3.1781132	3.1784013	3.1786892
151	3.1804126	3.1806992	3.1809856	3.1812718	3.1815578
152	3.1832698	3.1835545	3.1838390	3.1841233	3.1844075
153	3.1861084	3.1863812	3.1866739	3.1876563	3.1872386
154	3.1889285	3.1892095	3.1894903	3.1897709	3.1900514
155	3.1917304	3.1920096	3.1922886	3.1925674	3.1928461
156	3.1945143	3.1947917	3.1950690	3.1953460	3.1956229
157	3.1972806	3.1975562	3.1978317	3.1981070	3.1983821
158	3.2000293	3.2003032	3.2005769	3.2008505	3.2011239
159	3.2027607	3.2030329	3.2033049	3.2035768	3.2038485
160	3.2054750	3.2057455	3.2060159	3.2062869	3.2065560
161	3.2081725	3.2084413	3.2087100	3.2089785	3.2092468
162	3.2108534	3.2111203	3.2113876	3.2116544	3.2119211
163	3.2135178	3.2137833	3.2140487	3.2143139	3.2145789
164	3.2161659	3.2164298	3.2166936	3.2169572	3.2172206
165	3.2187980	3.2190603	3.2193225	3.2195845	3.2198464
166	3.2214142	3.2216750	3.2219356	3.2221960	3.2224563
167	3.2240148	3.2242740	3.2245331	3.2247920	3.2250507
168	3.2265999	3.2268576	3.2271151	3.2273724	3.2276296
169	3.2291697	3.2294258	3.2296818	3.2299377	3.2301934
170	3.2317244	3.2319790	3.2322335	3.2324879	3.2327421
171	3.2342641	3.2345173	3.2347703	3.2350232	3.2352759
172	3.2367891	3.2370408	3.2372923	3.2375437	3.2377950
173	3.2392995	3.2395497	3.2397998	3.2400498	3.2402996
174	3.2417954	3.2420442	3.2422929	3.2425414	3.2427898
175	3.2442771	3.2445245	3.2447718	3.2450189	3.2452658
176	3.2467447	3.2469907	3.2472365	3.2474823	3.2477278
177	3.2491984	3.2494430	3.2496874	3.2499317	3.2501759
178	3.2516382	3.2518814	3.2521246	3.2523675	3.2526103
179	3.2540645	3.2543063	3.2545481	3.2547897	3.2550312
180	3.2564772	3.2567177	3.2569581	3.2571984	3.2574386
181	3.2588766	3.2591158	3.2593549	3.2595939	3.2598327
182	3.2612629	3.2615008	3.2617385	3.2619762	3.2622137
183	3.2636361	3.2638727	3.2641092	3.2643455	3.2645817
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186	.2695129	.2697464	.2699797	.2702128	.2704459
187	.2718416	.2720738	.2723058	.2725378	.2727696
188	.2741578	.2743888	.2746196	.2748503	.2750809
189	.2764618	.2766915	.2769211	.2771506	.2773800
190	.2787536	.2789821	.2792105	.2794388	.2796669
191	3.2810334	3.2812607	3.2814879	3.2817150	3.2819419
192	.2833012	.2835274	.2837534	.2839793	.2842051
193	.2855573	.2857823	.2860071	.2862318	.2864565
194	.2878017	.2880255	.2882492	.2884728	.2886963
195	.2900346	.2902573	.2904798	.2907022	.2909246
196	.2922561	.2924776	.2926990	.2929203	.2931415
197	3.2944662	3.2946866	3.2949069	3.2951271	3.2953471
198	.2966652	.2968845	.2971036	.2973227	.2975417
199	.2988531	.2990713	.2992893	.2995073	.2997251
200	.3010300	.3012471	.3014641	.3016809	.3018977
201	.3031961	.3034121	.3036280	.3038438	.3040595
202	.3053514	.3055663	.3057811	.3059959	.3062105
203	3.3074960	3.3077099	3.3079237	3.3081374	3.3083509
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205	.3117539	.3119657	.3121774	.3123889	.3126004
206	.3138672	.3140780	.3142887	.3144992	.3147097
207	.3159703	.3161801	.3163897	.3165993	.3168087
208	.3180633	.3182721	.3184807	.3186893	.3188977
209	3.3201463	3.3203540	3.3205617	3.3207692	3.3209767
210	.3222193	.3224260	.3226327	.3228393	.3230457
211	.3242825	.3244882	.3246939	.3248995	.3251050
212	.3263359	.3265407	.3267454	.3269500	.3271545
213	.3283796	.3285834	.3287872	.3289909	.3291944
214	.3304138	.3306167	.3308195	.3310222	.3312248
215	3.3324385	3.3326404	3.3328423	3.3330440	3.3332457
216	.3344537	.3346548	.3348557	.3350565	.3352572
217	.3364597	.3366598	.3368598	.3370597	.3372595
218	.3384565	.3386557	.3388547	.3390537	.3392526
219	.3404441	.3406424	.3408405	.3410386	.3412366
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221	.3443923	.3445887	.3447851	.3449814	.3451776

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186	.2706788	.2709116	.2711443	.2713769	.2716093
187	.2730013	.2732328	.2734643	.2736956	.2739268
188	.2753113	.2755417	.2757719	.2760020	.2762320
189	.2776092	.2778383	.2780673	.2782962	.2785250
190	.2798950	.2801229	.2803507	.2805784	.2808059
191	3.2821688	3.2823955	3.2826221	3.2828486	3.2830750
192	.2844307	.2846563	.2848817	.2851070	.2853322
193	.2866810	.2869054	.2871296	.2873538	.2875778
194	.2889196	.2891428	.2893659	.2895889	.2898118
195	.2911468	.2913688	.2915908	.2918127	.2920344
196	.2933626	.2935835	.2938044	.2940251	.2942457
197	3.2955671	3.2957869	3.2960067	3.2962263	3.2964458
198	.2977605	.2979792	.2981979	.2984164	.2986348
199	.2999420	.3001605	.3003781	.3005955	.3008128
200	.3021144	.3023309	.3025474	.3027637	.3029799
201	.3042751	.3044905	.3047059	.3049212	.3051363
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203	3.3085644	3.3087778	3.3089910	3.3092042	3.3094172
204	.3106933	.3109056	.3111178	.3113299	.3115420
205	.3128118	.3130231	.3132343	.3134454	.3136563
206	.3149200	.3151303	.3153405	.3155505	.3157605
207	.3170181	.3172273	.3174365	.3176455	.3178545
208	.3191061	.3193143	.3195228	.3197305	.3199384
209	3.3211840	3.3213913	3.3215984	3.3218055	3.3220124
210	.3232521	.3234584	.3236645	.3238706	.3240766
211	.3253104	.3255157	.3257209	.3259260	.3261310
212	.3273589	.3275633	.3277675	.3279616	.3281757
213	.3293079	.3296012	.3298045	.3300077	.3302108
214	.3314273	.3316297	.3318320	.3320343	.3322364
215	3.3334473	3.3336488	3.3338501	3.3340514	3.3342526
216	.3354579	.3356585	.3358579	.3360593	.3362596
217	.3374593	.3376589	.3378584	.3380579	.3382572
218	.3394514	3396501	.3398488	.3400473	.3402458
219	.3414345	.3416323	.3418301	.3420277	.3422252
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224	.3502480	.3504419	.3506356	.3508293	.3510228
225	.3521825	.3523755	.3525684	.3527612	.3529539
226	.3541084	.3543006	.3544926	.3546845	.3548764
227	.3560259	.3562171	.3564083	.3565994	.3567905
228	3.3579348	3.3581253	3.3583156	3.3585059	3.3586961
229	.3598355	.3600251	.3602146	.3604040	.3605934
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231	.3636120	.3638000	.3639878	.3641756	.3643633
232	.3654880	.3656751	.3658622	.3660492	.3662361
233	.3673559	.3675423	.3677285	.3679147	.3681008
234	3.3692159	3.3694014	3.3695869	3.3697723	3.3699576
235	.3710679	.3712526	.3714373	.3716219	.3718065
236	.3729120	.3730960	.3732799	.3734637	.3736475
237	.3747483	.3749316	.3751147	.3752977	.3754807
238	.3765769	.3767594	.3769418	.3771240	.3773062
239	.3783979	.3785796	.3787612	.3789427	.3791241
240	3.3802112	3.3803922	3.3805730	3.3807538	3.3809345
241	.3820170	.3821072	.3823773	.3825573	.3827373
242	.3838154	.3839948	.3841741	.3843534	.3845326
243	.3856063	.3857850	.3859636	.3861421	.3863206
244	.3873898	.3875678	.3877457	.3877235	.3881012
245	.3891661	.3893433	.3895205	.3896975	.3898746
246	3.3909351	3.3911116	3.3912880	3.3914644	3.3916407
247	.3926969	.3928727	.3930485	.3932241	.3933997
248	.3944517	.3946268	.3948018	.3949767	.3951516
249	.3961993	.3963737	.3965480	.3967223	.3968964
250	.3979400	.3981137	.3982873	.3984608	.3986343
251	.3996737	.3998467	.4000196	.4001925	.4003653
252	3.4014005	3.4015728	3.4017451	3.4019172	3.4020893
253	.4031205	.4032921	.4034637	.4036352	.4038076
254	.4048337	.4050047	.4051755	.4053464	.4055171
255	.4065402	.4067105	.4068807	.4070508	.4072209
256	.4082400	.4084096	.4085791	.4087486	.4089180
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258	.4116197	.4117880	.4119562	.4121244	.4122925

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224	.3512163	.3514097	.3516031	.3517963	.3519895
225	.3531465	.3533391	.3535316	.3537239	.3539162
226	.3550682	.3552599	.3554515	.3556430	.3558345
227	.3569812	.3571723	.3571630	.3575537	.3577443
228	3.3588862	3.3590762	3.3592662	3.3594560	3.3596458
229	.3607827	.3609719	.3611610	.3613500	.3615390
230	.3626709	.3628593	.3630476	.3632358	.3634239
231	.3645510	.3647386	.3649260	.3651134	.3653007
232	.3664230	.3666097	.3667964	.3669830	.2671695
233	.3682869	.3684728	.3686587	.2688445	.3690302
234	3.3701428	3.3703280	3.3705131	3.3706981	3.3708830
235	.3719909	.3721753	.3723596	.3725438	.3727279
236	.3738311	.3740147	.3741983	.3743817	.3745651
237	.3756636	.3758464	.3760292	.3762118	.3763944
238	.3774884	.3776704	.3778524	.3780343	.3782161
239	.3793055	.3794868	.3796680	.3798492	.3800302
240	3.3811151	3.3812956	3.3814761	3.3816565	3.3818368
241	.3829171	.3830969	.3832766	.3834563	.3836359
242	.3847117	.3848908	.3850698	.3852487	.3854275
243	.3864990	.3866773	.3868555	.3870337	.3872118
244	.3882789	.3884565	.3886340	.3888114	.3889888
245	.3900515	.3902284	.3904052	.3905819	.3907585
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248	.3953264	.3955011	.3956758	.3958504	.3960249
249	.3970705	.3972446	.3974185	.3975924	.3977662
250	.3988077	.3989811	.3991543	.3993275	.3995007
251	.4005380	.4007106	.4008832	.4010557	.4012282
252	3.4022614	3.4024333	3.4026052	3.4027771	3.4029488
253	.4039780	.4041492	.4043205	.4044916	.4046627
254	.4056878	.4058584	.4060289	.4061994	.4063698
255	.4073909	4075608	.4077307	.4079005	.4080703
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262	.4183013	.4184670	.4186327	.4187983	.4189638
263	.4199557	.4201208	.4202859	.4204509	.4206158
264	.4216039	.4217684	.4219328	.4220972	4222614
265	3.4232459	3.4234097	3.4235735	3.4237372	3.4239009
266	.4248816	.4250449	.4252080	.4253712	.4255342
267	.4265113	.4266739	.4268365	.4269990	.4271614
268	.4281348	.4282958	.4284588	.4286207	.4287825
269	.4297523	.4299137	.4300751	.4302364	.4303976
270	.4313638	.4315246	.4316853	.4318460	.4320067
271	3.4329693	3.4331295	3.4332897	3.4334498	3.4336098
272	.4345689	.4347285	.4348881	.4350476	.4352071
273	.4361626	.4363217	.4364807	.4366396	.4367985
274	.4377506	.4379090	.4380674	.4382258	.4383841
275	.4393327	.4394906	.4396484	.4398062	.4399639
276	.4409091	.4410664	.4412237	.4413809	.4415380
277	3.4424798	3.4426365	3.4427932	3.4429499	3.4431065
278	.4440448	.4442010	.4443571	.4445132	.4446692
279	.4456042	.4457598	.4459154	.4460709	.4462264
280	.4471580	.4473131	.4474681	.4476231	.4477780
281	.4487063	.4488608	.4490153	.4491697	.4493241
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285	.4548449	.4549972	.4551495	.4553018	.4554540
286	.4563660	.4565179	.4566696	.4568213	.4569731
287	.4578819	.4580332	.4581844	.4583356	.4584868
288	.4493928	.4595433	.4596940	.4598446	.4599953
289	3.4608978	3.4610481	3.4611983	3.4613484	3.4614985
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293	.4668676	.4670158	.4671640	.4673120	.4674601
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261	.4174717	.4176377	.4178037	.4179696	.4181355
262	.4191293	.4192947	.4194601	.4196254	.4197906
263	.4207806	.4209454	.4211101	.4212748	.4214394
264	.4224257	.4225898	.4227539	.4229180	.4230820
265	3.4240645	3.4242281	3.4243915	3.4245550	3.4247183
266	.4256972	.4258601	.4260230	.4261858	.4263486
267	.4273238	.4274861	.4276484	.4278106	.4279727
268	.4288443	.4291060	.4292677	.4294293	.4295908
269	.4305588	.4307199	.4308809	.4310419	.4312029
270	.4321673	.4323278	.4324883	.4326487	.4328090
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273	.4369573	.4371161	.4372748	.4374334	.4375920
274	.4385423	.4387005	.4388587	.4390167	.4391747
275	.4401216	.4402792	.4404368	.4405943	.4407517
276	.4416951	.4418522	.4420092	.4421661	.4423229
277	3.4432630	3.4434195	3.4435759	3.4437322	3.4438885
278	.4448252	.4448911	.4451370	.4452928	.4454485
279	.4463818	.4465372	.4466925	.4468477	.4470029
280	.4479329	.4480877	.4482424	.4483971	.4485517
281	.4494784	.4496326	.4497868	.4499410	.4500951
282	.4510184	.4511721	.4513258	.4514794	.4516329
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285	.4556061	.4557582	.4559102	.4560622	.4562142
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288	.4601458	.4602963	.4604468	.4605972	.4607475
289	3.4616486	3.4617986	3.4619485	3.4620984	3.4622482
290	.4631461	.4632956	.4634450	.4635944	.4637437
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292	.4661259	.4662743	.4664227	.4665711	.4667194
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297	.4727564	.4729027	.4730488	.4731949	.4733410
298	.4742163	.4743620	.4745076	.4746533	.4747988
299	.4756712	.4758164	.4759616	.4761067	.4762518
300	.4771212	.4772660	.4774017	.4775553	.4776999
301	.4785665	.4787108	.4788550	.4789991	.4791432
302	3.4800069	3.4801507	3.4802945	3.4804381	3.4805818
303	.4814426	.4815859	.4817292	.4818724	.4820156
304	.4828736	.4830164	.4831592	.4833019	.4834446
305	.4842998	.4844422	.4845845	.4847268	.4848690
306	.4857214	.4858633	.4860052	.4861470	.4862888
307	.4871384	.4872798	.4874212	.4875626	.4877039
308	3.4885507	3.4886917	3.4888326	3.4889735	3.4891144
309	.4899585	.4900990	.4902395	.4903799	.4905203
310	.4913617	.4915018	.4916418	.4917818	.4919217
311	.4927604	.4929000	.4930396	.4931791	.4933186
312	.4941546	.4942938	.4944329	.4945720	.4947110
313	.4955443	.4956831	.4958218	.4959604	.4960990
314	3.4969296	3.4970679	3.4972062	3.4973444	3.4974825
315	.4983106	.4984484	.4985862	.4987240	.4988617
316	.4996871	.4998245	.4999619	.5000992	.5002365
317	.5010593	.5011962	.5013332	.5014701	.5016069
318	.5024271	.5025637	.5027002	.5028366	.5029731
319	.5037907	.5039268	.5040629	.5041989	.5043349
320	3.5051500	3.5052857	3.5054213	3.5055569	3.5056925
321	.5065050	.5066403	.5067755	.5069107	.5070459
322	.5078559	.5079907	.5081255	.5082603	.5083950
323	.5092025	.5093370	.5094713	.5096057	.5097400
324	.5105450	.5106790	.5108130	.5109469	.5110808
325	.5118834	.5120170	.5121505	.5122841	.5124175
326	3.5132176	3.5133508	3.5134840	3.5136171	3.5137501
327	.5145478	.5146805	.5148133	.5149460	.5150787
328	.5158738	.5160062	.5161386	.5162709	.5164031
329	.5171959	.5173279	.5174598	.5175917	.5177236
330	.5185139	.5186455	.5187771	.5189086	.5190400
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332	.5111381	.5212689	.5213996	.5215303	.5216610

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297	.4734870	.4736329	.4737788	.4739247	.4740705
298	.4749443	.4750898	.4752352	.4753806	.4755259
299	.4763968	.4765418	.4766867	.4768316	.4769765
300	.4778445	.4779890	.4781334	.4782778	.4784222
301	.4792873	.4794313	.4795753	.4797192	.4798631
302	3.4807254	3.4808689	3.4810124	3.4811559	3.4812993
303	.4821587	.4823018	.4824448	.4825878	.4827307
304	.4835873	.4837299	.4838725	.4840150	.4841574
305	.4850112	.4851533	.4852954	.4854375	.4855795
306	.4864305	.4865721	.4867138	.4868554	.4869969
307	.4878451	.4879863	.4881275	.4882686	.4884097
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310	.4920616	.4922014	.4923413	.4924810	.4926207
311	.4934580	.4935974	.4937368	.4938761	.4940154
312	.4948500	.4949890	.4951279	.4952667	.4954056
313	.4962375	.4963761	.4965145	.4966529	.4967913
314	3.4976206	3.4977587	3.4978967	3.4980347	3.4981727
315	.4989994	.4991370	.4992746	.4994121	.4995496
316	.5003737	.5005109	.5006481	.5007852	.5009222
317	.5017437	.5018805	.5020172	.5021539	.5022905
318	.5031094	.5032458	.5033821	.5035183	.5036545
319	.5044709	.5046068	.5047426	.5048785	.5050142
320	3.5058280	3.5059635	3.5060990	3.5062344	3.5063697
321	.5071810	.5073160	.5074511	.5075860	.5077210
322	.5085297	.5086644	.5087990	.5089335	.5090680
323	.5098743	.5100085	.5101427	.5102768	.5104109
324	.5112147	.5113485	.5114823	.5116160	.5117497
325	.5125510	.5126844	.5128178	.5129511	.5130844
326	3.5138832	3.5140162	3.5141491	3.5142820	3.5144149
327	.5152113	.5153439	.5154764	.5156089	.5157414
328	.5165354	.5166676	.5167997	.5169318	.5170639
329	.5178554	.5179872	.5181189	.5172506	.5183823
330	.5191715	.5193028	.5194342	.5195655	.5196968
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335	.5250448	.5251744	.5253040	.5254335	.5255631
336	.5263393	.5264685	.5265977	.5267269	.5268560
337	.5276299	.5277588	.5278876	.5280163	.5281451
338	.5289167	.5290452	.5291736	.5293020	.5294303
339	3.5301997	3.5303278	3.5304558	3.5305839	3.5307118
340	.5314789	.5316066	.5317343	.5318619	.5319895
341	.5327544	.5328817	.5330090	.5331363	.5332635
342	.5340261	.5341531	.5342800	.5344069	.5345338
343	.5352941	.5354207	.5355473	.5356738	.5358003
344	.5365584	.5366847	.5368109	.5369370	.5370631
345	3.5378191	3.5379450	3.5380708	3.5381966	3.5383223
346	.5390761	.5392016	.5393271	.5394525	.5395779
347	.5403295	.5404546	.5405797	.5407048	.5408298
348	.5415792	.5417040	.5418288	.5419535	.5420781
349	.5428254	.5429498	.5430742	.5431986	.5433229
350	.5440690	.5441921	.5443161	.5444401	.5445641
351	3.5453071	3.5454308	3.5455545	3.5456781	3.5458017
352	.5465427	.5466660	.5467894	.5469126	.5470359
353	.5477747	.5478977	.5480207	.5481436	.5482665
354	.5490033	.5491259	.5492486	.5493712	.5494937
355	.5502283	.5503507	.5504730	.5505952	.5507174
356	.5514500	.5515720	.5516939	.5518158	.5519377
357	3.5526682	3.5527898	3.5529114	3.5530330	3.5531545
358	.5538830	.5540043	.5541256	.5542468	.5543680
359	.5550944	.5552154	.5553362	.5554572	.5555781
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361	.5575072	.5576275	.5577477	.5578680	.5579881
362	.5587086	.5588285	.5589484	.5590683	.5591882
363	3.5599066	3.5600262	3.5601458	3.5602654	3.5603849
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367	.5646661	.5647844	.5649027	.5650209	.5651392
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369	.5670264	.5671440	.5672617	.5673793	.5674969

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335	.5256925	.5258219	.5259513	.5260807	.5262100
336	.5269851	.5271141	.5272431	.5273721	.5275010
337	.5282738	.5284024	.5285311	.5286596	.5287882
338	.5295587	.5296869	.5298152	.5299434	.5300716
339	3.5308398	3.5309677	3.5310955	3.5312234	3.5313512
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341	.5333907	.5335179	.5336450	.5337721	.5338991
342	.5346606	.5347874	.5349141	.5350408	.5351675
343	.5359267	.5360532	.5361795	.5363059	.5364322
344	.5371892	.5373153	.5374413	.5375672	.5376932
345	3.5384481	3.5385737	3.5386994	3.5388250	3.5389506
346	.5397032	.5398286	.5399538	.5400791	.5402043
347	.5409548	.5410798	.5412047	.5413296	.5414544
348	.5422028	.5423274	.5424519	.5425765	.5427010
349	.5434472	.5435714	.5436956	.5438198	.5439439
350	.5446880	.5448119	.5449358	.5450596	.5451834
351	3.5459253	3.5460489	3.5461724	3.5462958	3.5464193
352	.5471591	.5472823	.5474055	.5475286	.5476517
353	.5483894	.5485123	.5486351	.5487578	.5488806
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355	.5508392	.5509618	.5510839	.5512059	.5513280
356	.5520595	.5521813	.5523031	.5524248	.5525465
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359	.5556989	.5558197	.5559404	.5560612	.5561818
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362	.5593080	.5594278	.5595476	.5596673	.5597870
363	3.5605044	3.5606239	3.5607433	3.5608627	3.5609820
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365	.5628874	.5630062	.5631250	.5632437	.5633624
366	.5640740	.5641925	.5643109	.5644293	.5645477
367	.5652573	5653755	.5654936	.5656117	.5657298
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369	.5676144	.5677320	.5678494	.5679669	.5680843

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373	.5717088	.5718252	.5719416	.5720580	.5721743
374	.5728716	.5729877	.5731038	.5732198	.5733358
375	.5740313	.5741471	.5742628	.5743786	.5744943
376	3.5751878	3.5753033	3.5754188	3.5755342	3.5756496
377	.5763413	.5764565	.5765717	.5766868	.5768019
378	.5774917	.5776067	.5777215	.5778363	.5779511
379	.5786392	.5787538	.5788683	.5789828	.5790937
380	.5797836	.5790979	.5800121	.5801263	.5802405
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383	.5831988	.5833122	.5834255	.5835388	.5836521
384	.5843312	.5844443	.5845574	.5846704	.5847834
385	.5854607	.5855735	.5856863	.5857990	.5859117
386	.5865873	.5866998	.5868123	.5869247	.5870371
387	.5877110	.5878232	.5879353	.5880475	.5881596
388	3.5888317	3.5889436	3.5890555	3.5891674	3.5892792
389	.5899496	.5900612	.5901728	.5902844	.5903959
390	.5910646	.5911759	.5912873	.5913985	.5915098
391	.5921768	.5922878	.5923988	.5925098	.5926208
392	.5932861	.5933960	.5935076	.5936183	.5937290
393	.5943925	.5945030	.5946135	.5947239	.5948344
394	3.5954962	3.5956064	3.5957166	3.5958268	3.5959369
395	.5965971	.5967070	.5968169	.5969268	.5970367
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403	.6053050	.6054128	.6055215	.6056282	.6057359
404	.6063814	.6064888	.6065963	.6067037	.6068111
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406	.6085260	.6086330	.6087399	.6088468	.6089537

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372	.5711263	.5712428	.5713594	.5714759	.5715924
373	.5722906	.5724069	.5725231	.5726393	.5727555
374	.5734518	.5735678	.5736837	.5737990	.5739154
375	.5746099	.5747256	.5748412	.5749568	.5750723
376	3.5757650	3.5758803	3.5759956	3.5761109	3.5762261
377	.5769169	.5770320	.5771470	.5772620	.5773769
378	.5780659	.5781806	.5782953	.5784100	.5785246
379	.5792118	.5793262	.5794406	.5795550	.5796693
380	.5803547	.5804688	.5805829	.5806969	.5808110
381	.5814945	.5816084	.5817222	.5818359	.5819497
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383	.5837654	.5838786	.5839918	.5841050	.5842181
384	.5848963	.5850093	.5851222	.5852351	.5853479
385	.5860244	.5861370	.5862496	.5863622	.5864748
386	.5871495	.5872618	.5873742	.5874865	.5875987
387	.5882717	.5883838	.5884958	.5886078	.5887198
388	3.5893910	3.5895028	3.5896145	3.5897262	3.5898379
389	.5905075	.5906189	.5907304	.5908418	.5909532
390	.5916210	.5917322	.5918434	.5919546	.5920657
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392	.5938397	.5939503	.5940609	.5941715	.5942820
393	.5949447	.5950551	.5951654	.5952757	.5953860
394	3.5960470	3.5961571	3.5962671	3.5963771	3.5964871
395	.5971465	.5972563	.5973660	.5974758	.5975855
396	.5982432	.5983527	.5984622	.5985717	.5986811
397	.5993371	.5994464	.5995556	.5996648	.5997739
398	.6004283	.6005373	.6006462	.6007551	.6008640
399	.6015168	.6016255	.6017341	.6018428	.6019514
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403	.6058435	.6059512	.6060587	.6061663	.6062738
404	.6069185	.6070259	.6071332	.6072405	.6073478
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410	.6127839	.6128898	.6129957	.6131015	.6132073
411	.6138418	.6139475	.6140531	.6141587	.6142643
412	.6148972	.6150026	.6151080	.6152133	.6153187
413	3.6159501	3.6160552	3.6161603	3.6162654	3.6163705
414	.6170003	.6171052	.6172101	.6173149	.6174197
415	.6180481	.6181527	.6182573	.6183619	.6184665
416	.6190933	.6191977	.6193021	.6194064	.6195107
417	.6201360	.6202402	.6203443	.6204484	.6205524
418	.6211763	.6212802	.6213840	.6214879	.6215917
419	3.6222140	3.6223177	3.6224213	3.6225249	3.6226284
420	.6232493	.6233527	.6234560	.6235594	.6236627
421	.6242821	.6243852	.6244884	.6245915	.6246945
422	.6253124	.6254153	.6255182	.6256211	.6257239
423	.6263404	.6264430	.6265457	.6266483	.6267509
424	.6273659	.6274683	.6275707	.6276730	.6277754
425	3.6283889	3.6284911	3.6285933	3.6286954	3.6287975
426	.6294096	.6295115	.6296134	.6297153	.6298172
427	.6304279	.6305296	.6306312	.6307329	.6308354
428	.6314438	.6315452	.6316467	.6317481	.6318495
429	.6324573	.6325585	.6326597	.6327609	.6328620
430	.6334685	.6335694	.6336704	.6337713	.6338723
431	3.6344773	3.6345780	3.6346788	3.6347795	3.6348801
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433	.6364879	.6365882	.6366884	.6367887	.6368889
434	.6374897	.6375898	.6376898	.6377898	.6378898
435	.6384893	.6385891	.6386889	.6387887	.6388884
436	.6394865	.6395861	.6396857	.6397852	.6398847
437	3.6404814	3.6405808	3.6406802	3.6407795	3.6408788
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439	.6424645	.6425634	.6426623	.6427612	.6428601
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441	.6444386	.6445371	.6446355	.6447339	.6448323
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443	.6464037	.6465017	.6465997	.6466977	.6467957

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408	.6111921	.6112984	.6114046	.6115109	.6116171
409	.6122539	.6123599	.6124660	.6125720	.6126779
410	.6133132	.6134189	.6135147	.6136304	.6137361
411	.6143698	.6144754	.6145809	.6146863	.6147918
412	.6154240	.6155292	.6156345	.6157397	.6158449
413	3.6164755	3.6165805	3.6166855	3.6167905	3.6168954
414	.6175245	.6176293	.6177340	.6178387	.6179434
415	.6185710	.6186755	.6187800	.6188845	.6189889
416	.6196150	.6197193	.6198235	.6199277	.6200319
417	.6206565	.6207605	.6208645	.6209684	.6210724
418	.6216955	.6217992	.6219030	.6220067	.6221104
419	3.6227320	3.6228355	3.6229390	3.6230424	3.6231459
420	.6237660	.6238693	.6239725	.6240757	.6241789
421	.6247976	.6249006	.6250036	.6251066	.6252095
422	.6258267	.6259295	.6260322	.6261350	.6262377
423	.6268534	.6269559	.6270585	.6271610	.6272634
424	.6278777	.6279800	.6280823	.6281845	.6282867
425	3.6288996	3.6290016	3.6291036	3.6292057	3.6293076
426	.6299190	.6300208	.6301226	.6302244	.6303262
427	.6309361	.6310377	.6311392	.6312408	.6313423
428	.6319508	.6320522	.6321535	.6322548	.6323560
429	.6329632	.6330643	.6331653	.6332664	.6333674
430	.6339732	.6340740	.6341749	.6342757	.6343765
431	3.6349808	3.6350814	3.6351800	3.6352826	3.6353832
432	.6359861	.6360865	.6361869	.6362872	.6363870
433	.6369891	.6370893	.6371894	.6372895	.6373896
434	.6379898	.6380897	.6381896	.6382895	.6383894
435	.6389882	.6390879	.6391876	.6392872	.6393869
436	.6399842	.6400837	.6401832	.6402826	.6403820
437	3.6409781	3.6410773	3.6411765	3.6412758	3.6413749
438	.6419696	.6420686	.6421676	.6422666	.6423656
439	.6429589	.6430577	.6431565	.6432552	.6433540
440	.6439459	.6440445	.6441430	.6442416	.6443401
441	.6449307	.6450291	.6451274	.6452257	.6453240
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443	.6468936	.6469915	.6470894	.6471873	.6472851

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447	.6503075	.6504047	.6505018	.6505989	.6506960
448	.6512780	.6513749	.6514719	.6515687	.6516656
449	.6522463	.6523430	.6524397	.6525364	.6526331
450	3.6532125	3.6533090	3.6534055	3.6535019	3.6535984
451	.6541765	.6542728	.6543691	.6544653	.6545616
452	.6551384	.6552345	.6553306	.6554266	.6555226
453	.6560982	.6561941	.6562899	.6563857	.6564815
454	.6570559	.6571515	.6572471	.6573427	.6574383
455	.6580114	.6581068	.6582023	.6582976	.6583930
456	3.6589648	3.6590601	3.6591553	3.6592505	3.6593456
457	.6599162	.6600112	.6601062	.6602012	.6602962
458	.6608655	.6609603	.6610551	.6611499	.6612446
459	.6618127	.6619073	.6620019	.6620964	.6621910
460	.6627578	.6628522	.6629466	.6630410	.6631353
461	.6637009	.6637951	.6638893	.6639835	.9640776
462	3.6646420	3.6647360	3.6648299	3.6649239	3.6650178
463	.6655810	.6656748	.6657685	.6658623	.6659560
464	.6665180	.6666116	.6667051	.6667987	.6668922
465	.6674530	.6675463	.6676397	.6677331	.6678264
466	.6683859	.6684791	.6685723	.6686654	.6687585
467	.6693169	.6694099	.6695028	.6695958	.6696887
468	3.6702459	3.6703386	3.6704314	3.6705242	3.6706169
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471	.6730209	.6731131	.6732053	.6732974	.6733896
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473	.6748611	.6749529	.6750447	.6751365	.6752283
474	3.6757783	3.6758700	3.6759615	3.6760531	3.6761447
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446	.6498215	.6499187	.6500160	.6501132	.6502104
447	.6507930	.6508901	.6509871	.6510841	.6511811
448	.6517624	.6518593	.6519561	.6520528	.6521496
449	.6527297	.6528263	.6529229	.6530195	.6531160
450	3.6536948	3.6537912	3.6538876	3.6539839	3.6540802
451	.6545578	.6547539	.6548501	.6549462	.6550423
452	.6556186	.6557145	.6558105	.6559064	.6560023
453	.6565773	.6566730	.6567688	.6568645	.6569602
454	.6575339	.6576294	.6577250	.6578205	.6579159
455	.6584884	.6585837	.6586790	.6587743	.6588696
456	3.6594408	3.6595359	3.6596310	3.6597261	3.6598212
457	.6603911	.6604860	.6605809	.6606758	.6607706
458	.6613393	.6614340	.6615287	.6616234	.6617181
459	.6622855	.6623800	.6624745	.6625690	.6626634
460	.6632296	.6633239	.6634182	.6635125	.6636067
461	.6641717	.6642658	.6643599	.6644539	.6645480
462	3.6651117	3.6652056	3.6652995	3.6653933	3.6654872
463	.6660497	.6661434	.6662371	.6663307	.6664244
464	.6669857	.6670792	.6671727	.6672661	.6673595
465	.6679197	.6680130	.6681062	.6681995	.6682927
466	.6688516	.6689447	.6690378	.6691308	.6692239
467	.6697816	.6698745	.6699674	.6700602	.6701530
468	3.6707096	3.6708023	3.6708950	3.6709876	3.6710802
469	.6716356	.6717281	.6718206	.6719130	.6720054
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471	.6734817	.6735738	.6736659	.6737579	.6738500
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473	.6753200	.6754117	.6755034	.6755951	.6756867
474	3.6762362	3.6763277	3.6764192	3.6765107	3.6766022
475	.6771505	.6772418	.6773332	.6774244	.6775157
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477	.6789734	.6790643	.6791552	.6792461	.6793370
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485	.6857417	.6858313	.6859208	.6860103	.6860998
486	.6866363	.6867256	.6868149	.6869043	.6869936
487	3.6875290	3.6876181	3.6877073	3.6877964	3.6878855
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484	.6852938	.6853834	.6854730	.6855626	.6856522
485	.6861892	.6862787	.6863681	.6864575	.6865469
486	.6870828	.6871721	.6872613	.6873506	.6874398
487	3.6879746	3.6880637	3.6881528	3.6882418	3.6883308
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489	.6897527	.6898414	.6899301	.6900188	.6901074
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491	.6915235	.6916119	.6917002	.6917885	.6918768
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493	3.6932872	3.6933752	3.6934631	3.6935511	3.6936390
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521	.7168377	.7169211	.7170044	.7170877	.7171710
522	.7176705	.7177537	.7178369	.7179200	.7180032
523	.7185017	.7185847	.7186677	.7187507	.7188337
524	3.7193313	3.7194142	3.7194970	3.7195799	3.7196627
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535	.7283538	.7284349	.7285161	.7285972	.7286784
536	3.7291648	3.7292458	3.7293268	3.7294078	3.7294888
537	.7299743	.7300551	.7301360	.7302168	.7302977
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546	.7371926	.7372722	.7373517	.7374312	.7375107
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521	.7172543	.7173376	.7174208	.7175041	.7175873
522	.7180863	.7181694	.7182525	.7183356	.7184186
523	.7189167	.7189996	.7190826	.7191655	.7192484
524	3.7197455	3.7198283	3.7199111	3.7199938	3.7200766
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526	.7213984	.7214809	.7215633	.7216458	.7217282
527	.7222225	.7223048	.7223871	.7224694	.7225517
528	.7230450	.7231272	.7232093	.7232914	.7233736
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546	.7375902	.7376696	.7377491	.7378285	.7379079
547	.7383841	.7384634	.7385427	.7386220	.7387013
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558	.7466342	.7467120	.7467898	.7468676	.7469454
559	.7474118	.7474895	.7475672	.7476448	.7477225
560	.7481880	.7482656	.7483431	.7484206	.7484981
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562	.7497363	.7498136	.7498908	.7499681	.7500453
563	.7505084	.7505855	.7506626	.7507398	.7508168
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566	.7528164	.7528932	.7529699	.7530466	.7531232
567	3.7535831	3.7536596	3.7537362	3.7538128	3.7538893
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569	.7551123	.7551886	.7552649	.7553412	.7554175
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571	.7566361	.7567122	.7567882	.7568642	.7569402
572	.7573960	.7574719	.7575479	.7576237	.7576996
573	3.7581546	3.7582304	3.7583062	3.7583819	3.7584577
574	.7589119	.7589875	.7590632	.7591388	.7592144
575	.7596678	.7597434	.7598189	.7598944	.7599699
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578	.7619278	.7620030	.7620781	.7621532	.7622283
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586	.7678976	.7679717	.7680458	.7681199	.7681940
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589	.7701153	.7701890	.7702627	.7703364	.7704101
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591	.7715875	.7716610	.7717344	.7718079	.7718813

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557	.7462449	.7463228	.7464006	.7464785	.7465564
558	.7470232	.7471009	.7471787	.7472564	.7473341
559	.7478001	.7478777	.7479553	.7480329	.7481105
560	.7485756	.7486531	.7487306	.7488080	.7488854
561	3.7493498	3.7494271	3.7495044	3.7495817	3.7496590
562	.7501225	.7501997	.7502769	.7503541	.7504312
563	.7508939	.7509710	.7510480	.7511251	.7512021
564	.7516639	.7517409	.7518178	.7518947	.7519716
565	.7524326	.7525094	.7525862	.7526629	.7527397
566	.7531999	.7532766	.7533532	.7534292	.7535065
567	3.7539659	3.7540424	3.7541189	3.7541954	3.7542719
568	.7547305	.7548069	.7548832	.7549596	.7550359
569	.7554937	.7555700	.7556462	.7557264	.7557987
570	.7562556	.7563318	.7564079	.7564840	.7565600
571	.7570162	.7570922	.7571682	.7572441	.7573201
572	.7577755	.7578513	.7579272	.7580030	.7580788
573	3.7585334	3.7586091	3.7586848	3.7587605	3.7588362
574	.7592900	.7593656	.7594412	.7595168	.7595923
575	.7600453	.7601208	.7601962	.7602717	.7603471
576	.7607993	.7608746	.7609500	.7610253	.7611005
577	.7615520	.7616272	.7617024	.7617775	.7618527
578	.7623034	.7623784	.7624535	.7625285	.7626035
579	3.7630534	3.7631284	3.7632033	3.7632782	3.7633531
580	.7638022	.7638770	.7639518	.7640266	.7641014
581	.7645497	.7646244	.7646991	.7647737	.7648484
582	.7652959	.7653705	.7654450	.7655195	.7655941
583	.7660409	.7661153	.7661897	.7662641	.7663385
584	.7667845	.7668588	.7669331	.7670074	.3670816
585	3.7675269	3.7676011	3.7676752	3.7677494	3.7678235
586	.7682680	.7683421	.7684161	.7684901	.7685641
587	.7690079	.7690818	.7691557	.7692296	.7693035
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596	.7752463	.7753191	.7753920	.7754648	.7755376
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598	3.7767012	3.7767738	3.7768464	3.7769190	3.7769916
599	.7774268	.7774993	.7775718	.7776443	.7777167
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615	.7888751	.7889457	.7890163	.7890869	.7891575
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623	.7944880	.7945578	.7946274	.7946971	.7947668
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601	.7792356	.7793078	.7793800	.7794522	.7795243
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607	.7835463	.7836178	.7836892	.7837607	.7838321
608	.7842606	.7843319	.7844033	.7844746	.7845460
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615	.7892281	.7892986	.7893691	.7894397	.7895102
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620	.7927418	.7928118	.7928817	.7929517	.7930217
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622	3.7941394	3.7942091	3.7942789	3.7943486	3.7944183
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624	.7955324	.7956020	.7956715	.7957410	.7958105
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632	.8007171	.8007858	.8008545	.8009232	.8009919
633	.8014037	.8014723	.8015409	.8016095	.8016781
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648	.8115750	.8116420	.8117090	.8117760	.8118430
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647	3.8112398	3.8113068	3.8113739	3.8114409	3.8115080
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653	3.8152456	3.8153120	3.8153785	3.8154449	3.8155113
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668	.8247765	.8248415	.8249065	.8249715	.8250364
669	.8254261	.8254910	.8255559	.8256208	.8256857
670	.8260748	.8261396	.8262044	.8262692	.8263340
671	.8267225	.8267872	.8268519	.8269166	.8269813
672	3.8273693	3.8274339	3.8274985	3.8275631	3.8276277
673	.8280151	.8280796	.8281441	.8282086	.8282731
674	.8286599	.8287243	.8287887	.8288532	.8289176
675	.8293038	.8293681	.8294324	.8294967	.8295611
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679	.8318698	.8319337	.8319977	.8320616	.8321255
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681	.8331471	.8332109	.8332746	.8333384	.8334021
682	.8337844	.8338480	.8339117	.8339754	.8340390
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685	.8356906	.8357540	.8358174	.8358807	.8359441
686	.8363241	.8363874	.8364507	.8365140	.8365773
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693	.8407332	.8407959	.8408586	.8409212	.8409838
694	.8413595	.8414220	.8414846	.8415472	.8416097
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696	3.8426092	3.8426716	3.8427340	3.8427964	3.8428588
697	.8432328	.8432951	.8433574	.8434197	.8434819
698	.8438554	.8439176	.8439798	.8440420	.8441042
699	.8444772	.8445393	.8446014	.8446635	.8447256
700	.8450980	.8451601	.8452221	.8452841	.8453461
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668	.8251014	.8251664	.8252313	.8252963	.8253612
669	.8257506	.8258154	.8258803	.8259451	.8260100
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671	.8270460	.8271107	.8271753	.8272400	.8273046
672	3.8276923	3.8277569	3.8278214	3.8278860	3.8279505
673	.8283376	.8284021	.8284665	.8285310	.8285955
674	.8289820	.8290463	.8291107	.8291751	.8292394
675	.8296254	.8296896	.8297539	.8298182	.8298824
676	.8302678	.8303320	.8303962	.8304603	.8305245
677	.8309093	.8309734	.8310375	.8311016	.8311656
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680	.8328281	.8328919	.8329558	.8330195	.8330833
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694	.8416722	.8417348	.8417973	.8418598	.8419223
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696	3.8429211	3.8429835	3.8430458	3.8431081	3.8431705
697	.8435442	.8436065	.8436687	.8437310	.8434932
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705	.8481891	.8482507	.8483123	.8483739	.8484355
706	.8488047	.8488662	.8489277	.8489892	.8490507
707	.8494194	.8494808	.8495423	.8496037	.8496651
708	.8500333	.8500946	.8501559	.8502172	.8502786
709	3.8506462	3.8507075	3.8507687	3.8508300	3.8508912
710	.8512583	.8513195	.8513807	.8514418	.8515030
711	.8518696	.8519307	.8519917	.8520528	.8521139
712	.8524800	.8525410	.8526020	.8526629	.8527239
713	.8530895	.8531504	.8532113	.8532722	.8533331
714	.8536982	.8537590	.8538198	.8538806	.8539414
715	3.8543060	3.8543668	3.8544275	3.8544882	3.8545489
716	.8549130	.8549737	.8550343	.8550949	.8551556
717	.8555192	.8555797	.8556403	.8557008	.8557614
718	.8561244	.8561849	.8562454	.8563059	.8563663
719	.8567289	.8567893	.8568497	.8569101	.8569704
720	.8573325	.8573928	.8574531	.8575134	.8575737
721	3.8579353	3.8579955	3.8580557	3.8581159	3.8581761
722	.8585372	.8585973	.8586575	.8587176	.8587777
723	.8591383	.8591984	.8592584	.8593185	.8593785
724	.8597386	.8597985	.8598585	.8599185	.8599784
725	.8603380	.8603979	.8604578	.8605177	.8605776
726	.8609366	.8609964	.8610562	.8611160	.8611758
727	3.8615344	3.8615941	3.8616539	3.8617136	3.8617733
728	.8621314	.8621910	.8622507	.8623103	.8623699
729	.8627275	.8627871	.8628467	.8629062	.8629658
730	.8633229	.8633823	.8634418	.8635013	.8635608
731	.8639174	.8639768	.8640362	.8640956	.8641550
732	.8645111	.8645704	.8646297	.8646890	.8647483
733	3.8651040	3.8651632	3.8652225	3.8652817	3.8653409
734	.8656961	.8657552	.8658144	.8658735	.8659327
735	.8662873	.8663464	.8664055	.8664646	.8665236
736	.8668778	.8669368	.8669958	.8670548	.8671138
737	.8674675	.8675264	.8675853	.8676442	.8677031
738	.8680564	.8681152	.8681740	.8682329	.8682917
739	.8686444	.8687032	.8687620	.8688207	.8688794

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703	3.8472641	3.8473258	3.8473876	3.8474493	3.8475110
704	.8478810	.8479426	.8480043	.8480659	.8481275
705	.8484970	.8485586	.8486201	.8486817	.8487432
706	.8491122	.8491736	.8492351	.8492956	.8493580
707	.8497264	.8497878	.8498492	.8499106	.8499719
708	.8503399	.8504011	.8504624	.8505237	.8505850
709	3.8509524	3.8510136	3.8510748	3.8511360	3.8511972
710	.8515641	.8516252	.8516863	.8517474	.8518085
711	.8521749	.8522359	.8522970	.8523580	.8524100
712	.8527849	.8528458	.8529068	.8529677	.8530286
713	.8533940	.8534548	.8535157	.8535765	.8536374
714	.8540022	.8540630	.8541238	.8541845	.8542453
715	3.8546096	3.8546703	3.8547310	3.8547917	3.8548524
716	.8552162	.8552768	.8553374	.8553980	.8554586
717	.8558219	.8558824	.8559429	.8560035	.8560640
718	.8564268	.8564872	.8565476	.8566081	.8566685
719	.8570308	.8570912	.8571515	.8572118	.8572722
720	.8576340	.8576943	.8577545	.8578148	.8578750
721	3.8582363	3.8582965	3.8583567	3.8584169	3.8584770
722	.8588379	.8588980	.8589581	.8590181	.8590782
723	.8594385	.8594986	.8595586	.8596186	.8596786
724	.8600384	.8600983	.8601583	.8602182	.8602781
725	.8606374	.8606973	.8607571	.8608170	.86 8768
726	.8612356	.8612954	.8613552	.8614149	.8614747
727	3.8618330	3.8618927	3.8619524	3.8620120	3.8620717
728	.8624296	.8624892	.8625488	.8626084	.8626679
729	.8630253	.8630848	.8631443	.8632039	.8632634
730	.8636202	.8636797	.8637391	.8637985	.8638580
731	.8642143	.8642737	.8643331	.8643924	.8644517
732	.8648076	.8648669	.8649262	.8649855	.8650447
733	3.8654001	3.8654593	3.8655185	3.8655777	3.8656369
734	.8659918	.8660509	.8661100	.8661691	.8662282
735	.8665827	.8666417	.8667008	.8667598	.8668188
736	.8671728	.8672317	.8672907	.8673496	.8674086
737	.8677620	.8678209	.8678798	.8679387	.8679975
738	.8683505	.8684093	.8684681	.8685269	.8685857
739	.8689382	.8689969	.8690556	.8691143	.8691730

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742	.8704039	.8704624	.8705209	.8705795	.8706380
743	.8709888	.8710473	.8711057	.8711641	.8712226
744	.8715729	.8716313	.8716897	.8717480	.8718064
745	.8721563	.8722146	.8722728	.8723311	.8723894
746	3.8727388	3.8727970	3.8728552	3.8729134	3.8729716
747	.8733206	.8733788	.8734369	.8734950	.8735531
748	.8739016	.8739597	.8740177	.8740757	.8741338
749	.8744818	.8745398	.8745978	.8746557	.8747137
750	.8750613	.8751192	.8751771	.8752349	.8752928
751	.8756399	.8756978	.8757556	.8758134	.8758712
752	3.8762178	3.8762756	3.8763333	3.8763911	3.8764488
753	.8767950	.8768526	.8769103	.8769680	.8770256
754	.8773713	.8774289	.8774865	.8775441	.8776017
755	.8779469	.8780045	.8780620	.8781195	.8781770
756	.8785218	.8785792	.8786367	.8786941	.8787515
757	.8790959	.8791532	.8792106	.8792680	.8793253
758	3.8796692	3.8797265	3.8797838	3.8798411	3.8798983
759	.8802418	.8802990	.8803562	.8804134	.8804706
760	.8808136	.8808707	.8809279	.8809850	.8810421
761	.8813847	.8814417	.8814988	.8815558	.8816129
762	.8819550	.8820120	.8820689	.8821259	.8821829
763	.8825245	.8825815	.8826384	.8826953	.8827522
764	3.8830934	3.8831502	3.8832070	3.8832639	3.8833207
765	.8836614	.8837182	.8837750	.8838317	.8838885
766	.8842288	.8842855	.8843421	.8843988	.8844555
767	.8847954	.8848520	.8849086	.8849652	.8850218
768	.8853612	.8854178	.8854743	.8855308	.8855874
769	.8859263	.8859828	.8860393	.8860957	.8861522
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771	.8870544	.8871107	.8871670	.8872233	.8872796
772	.8876173	.8876736	.8877298	.8877860	.8878423
773	.8881795	.8882357	.8882918	.8883480	.8884042
774	.8887410	.8887971	.8888532	.8889093	.8889653
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776	.8898617	.8899177	.8899736	.8900296	.8900855

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741	.8701112	.8701697	.8702283	.8702868	.8703454
742	.8706965	.8707549	.8708134	.8708719	.8709304
743	.8712810	.8713394	.8713978	.8714562	.8715146
744	.8718647	.8719230	.8719814	.8720397	.8720980
745	.8724476	.8725059	.8725641	.8726224	.8726806
746	3.8730298	3.8730880	3.8731461	3.8732043	3.8732625
747	.8736112	.8736693	.8737274	.8737855	.8738435
748	.8741918	.8742498	.8743078	.8743658	.8744238
749	.8747716	.8748296	.8748875	.8749454	.8750034
750	.8753507	.8754086	.8754664	.8755243	.8755821
751	.8759290	.8759868	.8760445	.8761023	.8761601
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753	.8770833	.8771409	.8771985	.8772561	.8773137
754	.8776592	.8777168	.8777743	.8778319	.8778894
755	.8782345	.8782919	.8783494	.8784069	.8784643
756	.8788089	.8788663	.8789237	.8789811	.8790385
757	.8793826	.8794400	.8794973	.8795546	.8796119
758	3.8799556	3.8800128	3.8800701	3.8801273	3.8801846
759	.8805278	.8805850	.8806421	.8806993	.8807564
760	.8810992	.8811563	.8812134	.8812705	.8813276
761	.8816699	.8817269	.8817840	.8818410	.8818980
762	.8822398	.8822968	.8823537	.8824107	.8824676
763	.8828090	.8828659	.8829228	.8829797	.8830365
764	3.8833775	3.8834343	3.8834911	3.8835479	3.8836047
765	.8839452	.8840019	.8840586	.8841154	.8841721
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767	.8850784	.8851350	.8851915	.8852481	.8853047
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772	.8878985	.8879547	.8880109	.8880671	.8881233
773	.8884603	.8885165	.8885726	.8886287	.8886848
774	.8890214	.8890775	.8891336	.8891896	.8892457
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779	.8915375	.8915932	.8916489	.8917047	.8917604
780	.8920946	.8921503	.8922059	.8922616	.8923173
781	.8926510	.8927066	.8927622	.8928178	.8928734
782	.8932068	.8932623	.8933178	.8933733	.8934288
783	3.8937618	3.8938172	3.8938727	3.8939281	3.8939836
784	.8943161	.8943715	.8944268	.8944822	.8945376
785	.8948697	.8949250	.8949803	.8950356	.8950909
786	.8954225	.8954778	.8955330	.8955883	.8956435
787	.8959747	.8960299	.8960851	.8961403	.8961954
788	.8965262	.8965813	.8966364	.8966915	.8967466
789	3.8970770	3.8971320	3.8971871	3.8972421	3.8972971
790	.8976271	.8976821	.8977370	.8977920	.8978469
791	.8981765	.8982314	.8982863	.8983412	.8983960
792	.8987252	.8987800	.8988348	.8988897	.8989445
793	.8992732	.8993279	.8993827	.8994375	.8994922
794	.8998205	.8998752	.8999299	.8999846	.9000392
795	3.9003671	3.9004218	3.9004764	3.9005310	3.9005856
796	.9009131	.9009676	.9010222	.9010767	.9011313
797	.9014583	.9015128	.9015673	.9016218	.9016762
798	.9020029	.9020573	.9021117	.9021661	.9022205
799	.9025468	.9026011	.9026555	.9027098	.9027641
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804	.9052560	.9053101	.9053641	.9054181	.9054721
805	.9057960	.9058498	.9059038	.9059577	.9060116
806	.9063351	.9063889	.9064428	.9064967	.9065505
807	3.9068735	3.9069273	3.9069812	3.9070350	3.9070887
808	.9074114	.9074651	.9075188	.9075726	.9076263
809	.9079485	.9080022	.9080559	.9081095	.9081632
810	.9084850	.9085386	.9085922	.9086458	.9086994
811	.9090209	.9090744	.9091279	.9091815	.9092350
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813	.9100905	.9101440	.9101974	.9102508	.9103042

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778	.8912586	.8913144	.8913702	.8914259	.8914817
779	.8918161	.8918718	.8919275	.8919832	.8920389
780	.8923729	.8924285	.8924842	.8925398	.8925954
781	.8929290	.8929846	.8930401	.8930957	.8931512
782	.8934843	.8935398	.8935953	.8936508	.8937063
783	3.8940390	3.8940944	3.8941498	3.8942053	3.8942607
784	.8945929	.8946483	.8947037	.8947590	.8948143
785	.8951462	.8952015	.8952568	.8953120	.8953673
786	.8956987	.8957539	.8958091	.8958643	.8959195
787	.8962506	.8963057	.8963608	.8964160	.8964711
788	.8968017	.8968568	.8969118	.8969669	.8970220
799	3.8973521	3.8974071	3.8974621	3.8975171	3.8975721
790	.8979019	.8979568	.8980117	.8980667	.8981216
791	.8984509	.8985058	.8985606	.8986155	.8986703
792	.8989993	.8990541	.8991089	.8991636	.8992184
793	.8995469	.8996017	.8996564	.8997111	.8997658
794	.9000939	.9001486	.9002032	.9002579	.9003125
795	3.9006402	3.9006948	3.9007494	3.9008039	3.9008583
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797	.9017307	.9017851	.9018396	.9018940	.9019485
798	.9022749	.9023293	.9023837	.9024381	.9024924
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803	.9049859	.9050399	.9050940	.9051480	.9052020
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805	.9060656	.9061195	.9061734	.9062273	.9062812
806	.9066044	.9066582	.9067121	.9067659	.9068197
807	3.9071425	3.9071963	3.9072501	3.9073038	3.9073576
808	.9076800	.9077337	.9077874	.9078411	.9078948
809	.9082169	.9082705	.9083241	.9083778	.9084314
810	.9087530	.9088066	.9088602	.9089137	.9089673
811	.9092885	.9093420	.9093955	.9094490	.9095025
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817	.9122220	.9122752	.9123234	.9123815	.9124346
818	.9127533	.9128064	.9128595	.9129126	.9129656
819	.9132839	.9133369	.9133899	.9134430	.9134960
820	3.9138139	3.9138668	3.9139198	3.9139727	3.9140257
821	.9143432	.9143961	.9144489	.9145018	.9145547
822	.9148718	.9149246	.9149775	.9150303	.9150831
823	.9153998	.9154526	.9155054	.9155581	.9156109
824	.9159272	.9159799	.9160326	.9160853	.9161380
825	.9164539	.9165066	.9165592	.9166118	.9166645
826	3.9169800	3.9170326	3.9170852	3.9171378	3.9171903
827	.9175055	.9175580	.9176105	.9176630	.9177155
828	.9180303	.9180828	.9181352	.9181877	.9182401
829	.9185545	.9186069	.9186593	.9187117	.9187640
830	.9190781	.9191304	.9191827	.9192350	.9192873
831	.9196010	.9196533	.9197055	.9197578	.9198100
832	3.9201233	3.9201755	3.9202277	3.9202799	3.9203321
833	.9206450	.9206971	.9207493	.9208014	.9208535
834	.9211661	.9212181	.9212702	.9213222	.9213743
835	.9216865	.9217385	.9217905	.9218425	.9218945
836	.9222063	.9222582	.9223102	.9223621	.9224140
837	.9227255	.9227773	.9228292	.9228811	.9229330
838	3.9232440	3.9232958	3.9233477	3.9233995	3.9234513
839	.9237620	.9238137	.9238655	.9239172	.9239690
840	.9242793	.9243310	.9243827	.9244344	.9244860
841	.9247960	.9248476	.9248993	.9249509	.9250025
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843	.9258276	.9258791	.9259306	.9259821	.9260336
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845	.9268567	.9269081	.9269595	.9270109	.9270622
846	.9273704	.9274217	.9274730	.9275243	.9275757
847	.9278834	.9279347	.9279859	.9280372	.9280885
848	.9283959	.9284471	.9284983	.9285495	.9286007
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815	.9114240	.9114772	.9115305	.9115837	.9116369
816	.9119562	.9120094	.9120626	.9121157	.9121689
817	.9124878	.9125409	.9125940	.9126471	.9127002
818	.9130187	.9130717	.9131248	.9131778	.9132309
819	.9135490	.9136019	.9136549	.9137079	.9137609
820	3.9140786	3.9141315	3.9141844	3.9142373	3.9142903
821	.9146076	.9146604	.9147133	.9147661	.9148190
822	.9151359	.9151887	.9152415	.9152943	.9153471
823	.9156636	.9157163	.9157691	.9158218	.9158745
824	.9161907	.9162433	.9162960	.9163487	.9164013
825	.9167171	.9167697	.9168223	.9168790	.9169275
826	3.9172429	3.9172954	3.9173479	3.9174005	3.9174530
827	.9177680	.9178205	.9178730	.9179254	.9179779
828	.9182925	.9183449	.9183973	.9184497	.9185021
829	.9188164	.9188687	.9189211	.9189734	.9190258
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836	.9224659	.9225179	.9225698	.9226217	.9226736
837	.9229848	.9230367	.9230885	.9231404	.9231922
838	3.9235031	3.9235549	3.9236066	3.9236584	3.9237102
839	.9240208	.9240724	.9241242	.9241759	.9242276
840	.9245377	.9245894	.9246410	.9246927	.9247444
841	.9250541	.9251057	.9251573	.9252089	.9252605
842	.9255699	.9256215	.9256730	.9257245	.9257761
843	.9260851	.9261366	.9261880	.9262395	.9262910
844	3.9265997	3.9266511	3.9267025	3.9267539	3.9268053
845	.9271136	.9271650	.9272163	.9272677	.9273190
846	.9276270	.9276783	.9277296	.9277808	.9278321
847	.9281397	.9281909	.9282422	.9282934	.9283446
848	.9286518	.9287030	.9287542	.9288054	.9288565
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853	.9309490	.9309999	.9310508	.9311017	.9311526
854	.9314579	.9315087	.9315596	.9316104	.9316612
855	.9319661	.9320169	.9320677	.9321185	.9321692
856	.9324738	.9325245	.9325752	.9326259	.9326767
857	3.9329808	3.9330315	3.9330822	3.9331328	3.9331835
858	.9334873	.9335379	.9335885	.9336391	.9336897
859	.9339932	.9340437	.9340943	.9341448	.9341953
860	.9344984	.9345489	.9345994	.9346499	.9347004
861	.9350032	.9350536	.9351040	.9351544	.9352049
862	.9355073	.9355576	.9356080	.9356584	.9357087
863	3.9360108	3.9360611	3.9361114	3.9361617	3.9362120
864	.9365137	.9365640	.9366143	.9366645	.9367148
865	.9370161	.9370663	.9371165	.9371667	.9372169
866	.9375179	.9375680	.9376182	.9376683	.9377184
867	.9380191	.9380692	.9381193	.9381693	.9382194
868	.9385197	.9385698	.9386198	9386698	.9387198
869	3.9390198	3.9390697	3.9391197	3.9391697	3.9392196
870	.9395193	.9395692	.9396191	.9396690	.93 7189
871	.9400182	.9400680	.9401179	9401677	.9402176
872	.9405165	.9405663	.940616	.9406659	.9407157
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874	.9415114	.9415611	.9416108	9416605	.9417101
875	3.9420081	3.9420577	3.9421073	3.9421569	3.9422065
876	.9425041	.9425537	.9426032	.9426528	.9427024
877	.9429996	.9430491	.9430986	.9431481	.9431976
878	.9434945	.9435440	.9435934	.9436429	.9436923
879	.9439889	.9440383	.9440877	.9441371	.9441865
880	.9444827	.9445320	.9445814	.9446307	.9446800
881	3.9449759	3.9450252	3.9450745	3.9451238	3.9451730
882	.9454686	.9455178	.9455671	.9456163	.9456655
883	.9459607	.9460099	.9460591	.9461082	.9461574
884	.9464523	.9465014	.9465505	.9465996	.9466487
885	.9469433	.9469923	.9470414	.9470905	.9471395
886	.9474337	.9474827	.9475317	.9475807	.9476297
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854	.9317121	.9317629	.9318137	.9318645	.9319153
855	.9322200	.9322708	.9323215	.9323723	.9324230
856	.9327274	.9327781	.9328288	.9328795	.9329301
857	3.9332341	3.9332848	3.9333354	3.9333860	3.9334367
858	.9337403	.9337909	.9338415	.9338920	.9339426
859	.9342459	.9342964	.9343469	.9343974	.9344479
860	.9347509	.9348013	.9348518	.9349022	.9349527
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862	.9357591	.9358095	.9358598	.9359101	.9359605
863	3.9362623	3.9363126	3.9363629	3.9364132	3.9364635
864	.9367650	.9368152	.9368655	.9369157	.9369659
865	.9372671	.9373172	.9373674	.9374176	.9374677
866	.9377686	.9378187	.9378688	.9379189	.9379690
867	.9382695	.9383195	.9383696	.9384196	.9384697
868	.9387698	.9388198	.9388698	.9389198	.9389698
869	3.9392696	3.9393195	3.9393695	3.9394194	3.9394693
870	.9397688	.9398187	.9398685	.9399184	.9399683
871	.9402674	.9403172	.9403670	.9404169	.9404667
872	.9407654	.9408152	.9408650	.9409147	.9409645
873	.9412629	.9413126	.9413623	.9414120	.9414617
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875	3.9422561	3.9423058	3.9423553	3.9424049	3.9424545
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877	.9432471	.9432966	.9433461	.9433956	.9434450
878	.9437418	.9437912	.9438406	.9438900	.9439395
879	.9442358	.9442852	.9443346	.9443840	.9444333
880	.9447294	.9447787	.9448280	.9448773	.9449266
881	3.9452223	3.9452716	3.9453208	9.9453701	3.9454193
882	.9457147	.9457639	.9458131	.9458623	.9459115
883	.9462066	.9462557	.9463048	.9463540	.9464031
884	.9466978	.9467469	.9467960	.9468451	.9468942
885	.9471886	.9472376	.9472866	.9473357	.9473847
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891	.9498777	.9499264	.9499752	.9500139	.9500726
892	.9503649	.9504135	.9504622	.9505109	.9505596
893	.9508515	.9509001	.9509487	.9509973	.9510459
894	3.9513375	3.9513861	3.9514347	3.9514832	3.9515318
895	.9518230	.9518716	.9519201	.9519686	.9520171
896	.9523080	.9523565	.9524049	.9524534	.9525018
897	.9527924	.9528409	.9528893	.9529377	.9529861
898	.9532763	.9533247	.9533730	.9534214	.9534697
899	.9537597	.9538080	.9538563	.9539046	.9539529
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901	.9547248	.9547730	.9548212	.9548694	.9549176
902	.9552065	.9552547	.9553028	.9553510	.9553991
903	.9556877	.9557358	.9557839	.9558320	.9558801
904	.9561684	.9562165	.9562645	.9563125	.9563605
905	.9566486	.9566966	.9567445	.9567925	.9568405
906	3.9571282	3.9571761	3.9572241	3.9572720	3.9573199
907	.9576073	.9576552	.9577030	.9577509	.9577988
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919	.9633155	.9633628	.9634100	.9634573	.9635045
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921	.9642596	.9643068	.9643539	.9644011	.9644482
922	.9647309	.9647780	.9648251	.9648722	.9649193
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891	.9501213	.9501701	.9502188	.9502675	.9503162
892	.9506082	.9506569	.9507055	.9507542	.9508028
893	.9510946	.9511432	.9511918	.9512404	.9512889
894	3.9515803	3.9516289	3.9516774	3.9517260	3.9517745
895	.9520656	.9521141	.9521626	.9522111	.9522595
896	.9525503	.9525987	.9526472	.9526956	.9527440
897	.9530345	.9530828	.9531312	.9531796	.9532280
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901	.9549657	.9550139	.9550621	.9551102	.9551584
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903	.9559282	.9559762	.9560243	.9560723	.9561204
904	.9564686	.9564566	.9565046	.9565526	.9566006
905	.9568885	.9569364	.9569844	.9570323	.9570803
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917	.9626061	.9626534	.9627007	.9627481	.9627954
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919	.9635517	.9635990	.9636462	.9636934	.9637406
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928	.9675480	.9675498	.9676416	.9676883	.9677351
929	.9680157	.9680625	.9681092	.9681559	.9682027
930	.9684829	.9685296	.9685763	.9686230	.9686697
931	3.9689497	3.9689963	3.9690430	3.9690896	3.9691362
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933	.9698816	.9699282	.9699747	.9700213	.9700678
934	.9703469	.9703934	.9704399	.9704863	.9705328
935	.9708116	.9708581	.9709045	.9709509	.9709974
936	.9712758	.9713222	.9713686	.9714150	.9714614
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939	.9726656	.9727118	.9727581	.9728043	.9728506
940	.9731278	.9731741	.9732202	.9732664	.9733126
941	.9735896	.9736358	.9736819	.9737281	.9737742
942	.9740509	.9740970	.9741431	.9741892	.9742353
943	3.9745117	3.9745577	3.9746038	3.9746498	3.9746959
944	.9749720	.9750180	.9750640	.9751100	.9751560
945	.9754318	.9754778	.9755237	.9755697	.9756156
946	.9758911	.9759370	.9759829	.9760288	.9760747
947	.9763500	.9763958	.9764417	.9764875	.9765334
948	.9768083	.9768541	.9768999	.9769457	.9769915
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929	.9682494	.9682961	.9683428	.9683895	.9684362
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933	.9701143	.9701608	.9702074	.9702539	.9703004
934	.9705793	.9706258	.9706722	.9707187	.9707652
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936	.9715078	.9715542	.9716005	.9716469	.9716932
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939	.9728968	.9729430	.9729892	.9730354	.9730816
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941	.9738203	.9738664	.9739126	.9739587	.9740048
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964	.9840770	.9841221	.9841671	.9842122	.9842572
965	.9845273	.9845723	.9846173	.9846623	.9847073
966	.9849771	.9850221	.9850670	.9851120	.9851569
967	.9854265	.9854714	.9855163	.9855612	.9856061
968	3.9858754	3.9859202	3.9859651	3.9860099	3.9860548
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970	.9867717	.9868165	.9868613	.9869060	.9869508
971	.9872192	.9872640	.9873087	.9873534	.9873981
972	.9876668	.9877109	.9877556	.9878003	.9878449
973	.9881128	.9881575	.9882021	.9882467	.9882913
974	3.9885590	3.9886035	3.9886481	3.9886927	3.9887373
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982	.9921115	.9921557	.9921999	.9922441	.9922884
983	.9925535	.9925977	.9926419	.9926860	.9927302
984	.9929951	.9930392	.9930834	.9931275	.9931716
985	.9934362	.9934803	.9935244	.9935685	.9936126
986	3.9938769	3.9939210	3.9939650	3.9940090	3.9940531
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989	.9951963	.9952402	.9952841	.9953280	.9953719
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991	.9960737	.9961175	.9961613	.9962051	.9962489
992	3.9965117	3.9965554	3.9965992	3.9966430	3.9966868
993	.9969492	.9969930	.9970367	.9970804	.9971242
994	.9973864	.9974301	.9974738	.9975174	.9975611
995	.9978231	.9978667	.9979104	.9979540	.9979976
996	.9982593	.9983029	.9983465	.9983901	.9984337
997	.9986952	.9987387	.9987823	.9988268	.9988694
998	.9991305	.9991740	.9992176	.9994611	.9993046
999	.9995655	.9996090	.9996524	.9992959	.9997393

Num.	5	6	7	8	9
962	3.9834007	3.9834459	3.9834910	3.9835361	3.9835812
963	.9838517	.9838968	.9839419	.9839869	.9840320
964	.9843022	.9843473	.9843923	.9844373	.9844823
965	.9847523	.9847973	.9848422	.9848872	.9849322
966	.9852019	.9852468	.9852917	.9853366	.9853816
967	.9856510	.9856959	.9857407	.9857856	.9858305
968	3.9860996	3.9861445	3.9861893	3.9862341	3.9862790
969	.9865478	.9865926	.9866374	.9866822	.9867270
970	.9869955	.9870403	.9870850	.9871298	.9871745
971	.9874428	.9874875	.9875322	.9875769	.9876216
972	.9878895	.9879343	.9879789	.9880236	.9880682
973	.9883360	.9883806	.9884252	.9884698	.9885144
974	3.9887818	3.9888264	3.9888710	3.9889155	3.9889601
975	.9892273	.9892718	.9893163	.9893608	.9894053
976	.9896722	.9897167	.9897612	.9898056	.9898501
977	.9901168	.9901612	.9902056	.9902500	.9902944
978	.9905608	.9906052	.9906496	.9906940	.9907383
979	.9910044	.9910488	.9910931	.9911374	.9911818
980	3.9914476	3.9914919	3.9915362	3.9915805	3.9916247
981	.9918903	.9919345	.9919788	.9920230	.9920673
982	.9923326	.9923768	.9924210	.9924651	.9925093
983	.9927744	.9928185	.9928627	.9929068	.9929510
984	.9932157	.9932598	.9933039	.9933480	.9933921
985	.9936506	.9937007	.9937448	.9937888	.9938329
986	3.9940971	3.9941411	3.9941851	3.9942291	3.9942731
987	9945371	.9945811	.9946251	.9946690	.9947130
988	.9949767	.9950206	.9950645	.9951085	.9951524
989	.9954158	.9954597	.9955036	.9955474	.9955913
990	.9958545	.9958983	.9959422	.9959860	.9960298
991	.9962927	.9963365	.9963803	.9964241	.9964679
992	3.9967303	3.9967743	3.9968180	3.9968618	3.9969055
993	.9971679	.9972116	.9972553	.9972990	.9973427
994	.9976048	.9976485	.9976921	.9977358	.9977794
995	.9980413	.9980849	.9981285	.9981721	.9982157
996	.9984773	.9985209	.9985645	.9986080	.9986516
997	.9989129	.9989564	.9990000	.9990435	.9990870
998	.9993481	.9993916	.9994350	.9994785	.9995220
999	.9997828	.9998262	.9998697	.9999131	.9999566

A
Triangular Canon
Logarithmical:

OR, A

TABLE

OF

Artificial Sines, Tangents, & Secants,

The RADIUS 10.0000000;

And to every Degree and Minute of the
QUADRANT.

LONDON;
Printed by *John Darby*, for *John Seller* and
Richard Mount, 1694.

A Table of Artificial Sines,

0 *Degrees.*

M	Sine.		Tang		Secant		
0	0.0000000	10.0000000	0.0000000	Infinite.	10.0000000	Infinite.	60
1	6.4637261	9.9999999	6.4637261	13.5362739	10.0000000	13.5362739	59
2	6.7647561	9.9999999	6.7647562	13.2352438	10.0000001	13.2352439	58
3	6.9408473	9.9999998	6.9408475	13.0591525	10.0000002	13.0591527	57
4	7.0657860	9.9999997	7.0657863	12.9342137	10.0000003	12.9342140	56
5	7.1626960	9.9999995	7.1626964	12.8373036	10.0000005	12.8373040	55
6	7.2418771	9.9999993	7.2418778	12.7581222	10.0000007	12.7581229	54
7	7.3088239	9.9999991	7.3088247	12.6911752	10.0000009	12.6911761	53
8	7.3668157	9.9999988	7.3668169	12.6331831	10.0000012	12.6331843	52
9	7.4179681	9.9999985	7.4179696	12.5820304	10.0000015	12.5820319	51
10	7.4637255	9.9999982	7.4637273	12.5362727	10.0000013	12.5362745	50
11	7.5051181	9.9999978	7.5051203	12.4948797	10.0000022	12.4948819	49
12	7.5429065	9.9999974	7.5429091	12.4570909	10.0000026	12.4570935	48
13	7.5776684	9.9999969	7.5776715	12.4223285	10.0000031	12.4223316	47
14	7.6098530	9.9999964	7.6098566	12.3901434	10.0000036	12.3901470	46
15	7.6398160	9.9999959	7.6398201	12.3601799	10.0000041	12.3601840	45
16	7.6678445	9.9999953	7.6678492	12.3321508	10.0000047	12.3321555	44
17	7.6941733	9.9999947	7.6941786	12.3058214	10.0000053	12.3058267	43
18	7.7189966	9.9999940	7.7190026	12.2809974	10.0000060	12.2810034	42
19	7.7424775	9.9999934	7.7424841	12.2575159	10.0000066	12.2575225	41
20	7.7647537	9.9999927	7.7647610	12.2352390	10.0000073	12.2352463	40
21	7.7859427	9.9999919	7.7859508	12.2140492	10.0000081	12.2140573	39
22	7.8061458	9.9999911	7.8061547	12.1938453	10.0000089	12.1938542	38
23	7.8254507	9.9999903	7.8254604	12.1745396	10.0000097	12.1745493	37
24	7.8439338	9.9999894	7.8439444	12.1560556	10.0000106	12.1560662	36
25	7.8616623	9.9999885	7.8616738	12.1383262	10.0000115	12.1383377	35
26	7.8786953	9.9999876	7.8787077	12.1212923	10.0000124	12.1213047	34
27	7.8950854	9.9999866	7.8950988	12.1049012	10.0000134	12.1049146	33
28	7.9108793	9.9999856	7.9108938	12.0891062	10.0000144	12.0891207	32
29	7.9261190	9.9999845	7.9261344	12.0738656	10.0000155	12.0738810	31
30	7.9408419	9.9999835	7.9408584	12.0591416	10.0000165	12.0591581	30
		Sine.		Tang		Secant	M

89 *Degrees.*

0 Degrees.

M	Sine.		Tang		Secant		
30	7.9408419	9.9999835	7.9408584	12.0591416	10.0000165	12.0591581	30
31	7.9550819	9.9999823	7.9550996	12.0449004	10.0000177	12.0449181	29
32	7.9688698	9.9999812	7.9688886	12.0311114	10.0000188	12.0311302	28
33	7.9822334	9.9999800	7.9822534	12.0177466	10.0000200	12.0177666	27
34	7.9951980	9.9999788	7.9952192	12.0047808	10.0000212	12.0048020	26
35	8.0077867	9.9999775	8.0078092	11.9921908	10.0000225	11.9922133	25
36	8.0200207	9.9999762	8.0200445	11.9799555	10.0000238	11.9799793	24
37	8.0319195	9.9999748	8.0319446	11.9680554	10.0000252	11.9680805	23
38	8.0435009	9.9999735	8.0435274	11.9564726	10.0000265	11.9564991	22
39	8.0547814	9.9999721	8.0548094	11.9451906	10.0000279	11.9452186	21
40	8.0657763	9.9999706	8.0658057	11.9341943	10.0000294	11.9342237	20
41	8.0764997	9.9999691	8.0765306	11.9234694	10.0000309	11.9235003	19
42	8.0869646	9.9999676	8.0869970	11.9130030	10.0000324	11.9130354	18
43	8.0971832	9.9999660	8.0972172	11.9027828	10.0000340	11.9028168	17
44	8.1071669	9.9999644	8.1072025	11.8927975	10.0000356	11.8928331	16
45	8.1169262	9.9999628	8.1169634	11.8830366	10.0000372	11.8830738	15
46	8.1264710	9.9999611	8.1265099	11.8734901	10.0000389	11.8735290	14
47	8.1358104	9.9999594	8.1358510	11.8641490	10.0000406	11.8641896	13
48	8.1449532	9.9999577	8.1449956	11.8550044	10.0000423	11.8550468	12
49	8.1539075	9.9999559	8.1539516	11.8460484	10.0000441	11.8460925	11
50	8.1626808	9.9999541	8.1627267	11.8372733	10.0000459	11.3373192	10
51	8.1712804	9.9999522	8.1713282	11.8286718	10.0000478	11.8287196	9
52	8.1797129	9.9999503	8.1797626	11.8202374	10.0000497	11.8202871	8
53	8.1879848	9.9999484	8.1880364	11.8119636	10.0000516	11.8120152	7
54	8.1961020	9.9999464	8.1961556	11.8038444	10.0000536	11.8038980	6
55	8.2040703	9.9999444	8.2041259	11.7958741	10.0000556	11.7959297	5
56	8.2118949	9.9999424	8.2119526	11.7880474	10.0000576	11.7881051	4
57	8.2195811	9.9999403	8.2196409	11.7803592	10.0000597	11.7804189	3
58	8.2271335	9.9999382	8.2271953	11.7728047	10.0000618	11.7728665	2
59	8.2345568	9.9999360	8.2346208	11.7653792	10.0000640	11.7654432	1
60	8.2418553	9.9999338	8.2419215	11.7580785	10.0000662	11.7581447	0
		Sine.		Tang.		Secant	M

89 Degrees.

A Table of Artificial Sines,

1 Degree.

M	Sine.		Tang		Secant		
0	8.2418553	9.9399338	8.2419215	11.7580785	10.0000661	11 7581447	60
1	8.2490332	9.9999316	8.2491015	11.7508985	10.0000684	11.7509668	59
2	8.2560943	9.9999294	8.2561649	11.7438351	10.0000706	11.7439057	58
3	8.2630424	9.9999271	8.2631153	11.7368847	10.0000729	11.7369576	57
4	8.2698810	9.9999247	8.2699563	11.7300437	10.0000753	11.73018[illegible]	56
5	8.2766136	9.9999224	8.2766912	11.7233088	10.0000776	11 7233864	55
6	8.2832434	9.9999200	8.2833234	11.7166766	10.0000800	11.7167566	54
7	8.2897734	9.9999175	8.2898559	11.7101441	10.0000825	11.7102266	53
8	8.2962067	9.9999150	8.2962917	11.7037083	10.0000850	11.7037933	52
9	8.3025460	9.9999125	8.3026335	11.6973665	10.0000875	11.6974540	51
10	8.3087941	9.9999100	8.3088842	11.6911158	10.0000900	11.6912059	50
11	8.3149536	9.9999074	8.3150462	11.6849538	10.0000926	11.6850464	49
12	8.3210269	9.9999047	8.3211221	11.6788779	10.0000953	11.6789731	48
13	8.3270163	9.9999021	8.3271143	11.6728857	10.0000979	11.6729837	47
14	8.3329243	9.9998994	8.3330249	11.6669751	10.0001006	11.6670757	46
15	8.3387529	9.9998966	8.3388563	11.6611437	10.0001034	11.6612471	45
16	8.3445043	9.9998939	8.3446105	11.6553895	10.0001061	11.6554957	44
17	8.3501805	9.9998911	8.3502895	11.6497105	10.0001089	11.6498195	43
18	8.3557835	9.9998882	8.3558953	11.6441047	10.0001118	11.6442165	42
19	8.3613150	9.9998853	8.3614297	11.6385703	10.0001147	11.6386850	41
20	8.3667769	9.9998824	8.3668945	11.6331055	10.0001176	11.6332231	40
21	8.3721710	9.9998794	8.3722915	11.6277085	10.0001206	11.6278290	39
22	8.3774988	9.9998764	8.3776223	11.6223777	10.0001236	11.6225012	38
23	8.3827620	9.9998734	8.3828886	11.6171114	10.0001266	11.6172380	37
24	8.3879622	9.9998703	8.3880918	11.6119082	10.0001297	11.6120378	36
25	8.3931008	9.9998672	8.3932336	11.6067664	10.0001328	11.6068992	35
26	8.3981793	9.9998641	8.3983152	11.6016848	10.0001359	11.6018207	34
27	8.4031990	9.9998609	8.4033381	11.5966619	10.0001391	11.5968010	33
28	8.4081614	9.9998577	8.4083037	11.5916963	10.0001423	11.5918386	32
29	8.4130676	9.9998544	8.4132132	11.5867868	10.0001456	11.5869324	31
30	8.4179190	9.9998512	8.4180679	11.5819321	10.0001488	11.5820810	30
		Sine.		Tang		Secant	M

88 Degrees.

1 Degree.

M	Sine.		Tang		Secant		
30	8.4179190	9.9998512	8.4180679	11.5819321	10.0001488	11.5820810	30
31	8.4227168	9.9998478	8.4228690	11.5771310	10.0001522	11.5772832	29
32	8.4274621	9.9998445	8.4276176	11.5723824	10.0001555	11.5725379	28
33	8.4321561	9.9998411	8.4323150	11.5676850	10.0001589	11.5678439	27
34	8.4367999	9.9998376	8.4369622	11.5630378	10.0001624	11.5632001	26
35	8.4413944	9.9998342	8.4415603	11.5584397	10.0001658	11.5586056	25
36	8.4459409	9.9998306	8.4461103	11.5538897	10.0001694	11.5540591	24
37	8.4504402	9.9998271	8.4506131	11.5493869	10.0001729	11.5495598	23
38	8.4548934	9.9998235	8.4550699	11.5449301	10.0001765	11.5451066	22
39	8.4593012	9.9998199	8.4594814	11.5405186	10.0001801	11.5406987	21
40	8.4636649	9.9998162	8.4638486	11.5361514	10.0001838	11.5363351	20
41	8.4679850	9.9998125	8.4681725	11.5318275	10.0001875	11,5320150	19
42	8.4722626	9.9998088	8.4724538	11.5275462	10.0001912	11.5277374	18
43	8.4764984	9.9998050	8.4766633	11.5233067	10.0001950	11 5235016	17
44	8.4806932	9.9998012	8.4808920	11.5191080	10.0001980	11 5193068	16
45	8.4848479	9.9997974	8.4850505	11.5149495	10 0002026	11.5151521	15
46	8.4889632	9.9997935	8.4891696	11.5108304	10.0002065	11.5110368	14
47	8.4930398	9.9997896	8.4932502	11.5067498	10.0002104	11.5069602	13
48	8.4970784	9.9997856	8.4972928	11.5027072	10.0002144	11.5029216	12
49	8.5010798	9.9997817	8.5012982	11.4987018	10 0002183	11.4989202	11
50	8.5050447	9.9997776	8.5052672	11.4947329	10 0002224	11.4949553	10
51	8.5089736	9.9997736	8.5092001	11.4907999	10.0002264	11 4910264	9
52	8.5128673	9.9997695	8.5130978	11.4869022	10 0002305	11.4871327	8
53	8.5167264	9.9997653	8.5169610	11.4830387	10.0002347	11.4832736	7
54	8.5205514	9.9997612	8.5207902	11.4792098	10.0002388	11.4794486	6
55	8.5243430	9.9997570	8.5245860	11.4754140	10.0002430	11.4756570	5
56	8.5281017	9 9997527	8.5283490	11.4716510	10.0002473	11.4718983	4
57	8.5318281	9.9997484	8.5320797	11.4679203	10.0002516	11.4681719	3
58	8.5355228	9.9997441	8.5357787	11.4642213	10.0002559	11.4644772	2
59	8.5391863	9.9997398	8.5394466	11.4605534	10.0002602	11.4608137	1
60	8.5428192	9 9997354	8.5430838	11.4569162	10 0002646	11.4571808	0
		Sine.		Tang.		Secant	M

88 Degrees.

A Table of Artificial Sines,

2 Degrees.

M	Sine.		Tang		Secant		
0	8.5428192	9.9997354	8.5430838	11.4569162	10.0002646	11.4571808	60
1	8.5464218	9.9997309	8.5466909	11.4533091	10.0002691	11.4535782	59
2	8.5499948	9.9997265	8.5502683	11.4497317	10.0002735	11.4500052	58
3	8.5535386	9.9997220	8.5538166	11.4461834	10.0002780	11.4464614	57
4	8.5570536	9.9997174	8.5573362	11.4426638	10.0002826	11.4429464	56
5	8.5605404	9.9997128	8.5608276	11.4391724	10.0002872	11.4394596	55
6	8.5639994	9.9997082	8.5642912	11.4357088	10.0002918	11.4360006	54
7	8.5674310	9.9997036	8.5677275	11.4322725	10.0002964	11.4325690	53
8	8.5708357	9.9996989	8.5711368	11.4288632	10.0003011	11.4291643	52
9	8.5742139	9.9996942	8.5745197	11.4254803	10.0003058	11.4257861	51
10	8.5775660	9.9996894	8.5778766	11.4221234	10.0003106	11.4224340	50
11	8.5808923	9.9996846	8.5812077	11.4187923	10.0003154	11.4191077	49
12	8.5841933	9.9996798	8.5845136	11.4154864	10.0003202	11.4158067	48
13	8.5874694	9.9996749	8.5877945	11.4122055	10.0003251	11.4125306	47
14	8.5907209	9.9996700	8.5910509	11.4089491	10.0003300	11.4092791	46
15	8.5939483	9.9996650	8.5942832	11.4057168	10.0003350	11.4060517	45
16	8.5971517	9.9996601	8.5974917	11.4025083	10.0003399	11.4028483	44
17	8.6003317	9.9996550	8.6006767	11.3993233	10.0003450	11.3996683	43
18	8.6034886	9.9996500	8.6038386	11.3961614	10.0003500	11.3965114	42
19	8.6066225	9.9996449	8.6069777	11.3930223	10.0003551	11.3933774	41
20	8.6097341	9.9996398	8.6100943	11.3899057	10.0003602	11.3902659	40
21	8.6128235	9.9996346	8.6131889	11.3868111	10.0003654	11.3871765	39
22	8.6158910	9.9996264	8.6162616	11.3837384	10.0003706	11.3841090	38
23	8.6189369	9.9996242	8.6193127	11.3806873	10.0003758	11.3810631	37
24	8.6219616	9.9996189	8.6223427	11.3776573	10.0003811	11.3780384	36
25	8.6249653	9.9996136	8.6253518	11.3746482	10.0003864	11.3750347	35
26	8.6279484	9.9996082	8.6283402	11.3716598	10.0003918	11.3720516	34
27	8.6309111	9.9996028	8.6313083	11.3686917	10.0003972	11.3690889	33
28	8.6338537	9.9995974	8.6342563	11.3657437	10.0004026	11.3661463	32
29	8.6367764	9.9995919	8.6371845	11.3628155	10.0004081	11.3632236	31
30	8.6396796	9.9995865	8.6400931	11.3599059	10.0004135	11.3603204	30
		Sine.		Tang		Secant	M

87 Degrees.

2 *Degrees.*

M	Sine		Tang		Secant		
30	8.6396796	9.9995865	8.6400931	11.3599069	10.0004135	11.3603204	30
31	8.6425634	9.9995809	8.6429825	11.3570175	10.0004191	11.3574366	29
32	8.6454282	9.9995753	8.6458528	11.3541472	10.0004247	11.3545718	28
33	8.6482742	9.9995697	8.6487044	11.3512956	10.0004303	11.3517258	27
34	8.6511016	9.9995641	8.6515375	11.3484625	10.0004359	11.3488984	26
35	8.6539107	9.9995584	8.6543525	11.3456478	10.0004416	11.3460893	25
36	8.6567017	9.9995527	8.6571490	11.3428510	10.0004473	11.3432983	24
37	8.6594748	9.9995469	8.6599279	11.3400721	10.0004530	11.3405252	23
38	8.6622303	9.9995411	8.6626891	11.3373109	10.0004589	11.3377697	22
39	8.6649684	9.9995353	8.6654331	11.3345669	10.0004647	11.3350316	21
40	8.6676893	9.9995294	8.6681598	11.3318402	10.0004705	11.3323107	20
41	8.6703933	9.9995236	8.6708697	11.3291303	10.0004764	11.3296068	19
42	8.6730804	9.9995176	8.6735628	11.3264372	10.0004824	11.3269196	18
43	8.6757510	9.9995116	8.6762393	11.3237607	10.0004884	11.3242490	17
44	8.6784052	9.9995056	8.6788996	11.3211004	10.0004944	11.3215948	16
45	8.6810433	9.9994996	8.6815437	11.3184563	10.0005004	11.3189567	15
46	8.6836654	9.9994935	8.6841719	11.3158281	10.0005065	11.3163346	14
47	8.6862718	9.9994874	8.6867844	11.3132156	10.0005126	11.3137282	13
48	8.6888625	9.9994812	8.6893813	11.3106187	10.0005188	11.3111375	12
49	8.6914379	9.9994750	8.6919629	11.3080371	10.0005250	11.3085621	11
50	8.6939980	9.9994688	8.6945292	11.3054708	10.0005312	11.3060019	10
51	8.6965431	9.9994625	8.6970806	11.3029194	10.0005375	11.3034569	9
52	8.6990734	9.9994562	8.6996172	11.3003828	10.0005438	11.3009266	8
53	8.7015889	9.9994498	8.7021390	11.2978610	10.0005502	11.2984111	7
54	8.7040899	9.9994435	8.7046465	11.2953535	10.0005565	11.2959101	6
55	8.7065766	9.9994370	8.7071395	11.2928605	10.0005630	11.2934234	5
56	8.7090490	9.9994306	8.7096185	11.2903815	10.0005694	11.2909510	4
57	8.7115075	9.9994241	8.7120834	11.2879166	10.0005759	11.2884925	3
58	8.7139520	9.9994176	8.7145345	11.2854655	10.0005824	11.2860480	2
59	8.7163829	9.9994110	8.7169719	11.2830281	10.0005890	11.2836171	1
60	8.7188002	9.9994044	8.7193958	11.2806042	10.0005956	11.2811998	0
		Sine.		Tang		Secant	M

87 *Degrees.*

3 Degrees.

M	Sine.		Tang		Secant		
0	8.7188002	9.9994044	8.7193958	11.2806042	10.0005956	11.2811998	60
1	8.7212040	9.9993978	8.7218063	11.2781937	10.0006022	11.2787960	59
2	8.7235946	9.9993911	8.7242035	[illegible]	10.0006089	[illegible]	58
3	8.7259721	9.9993844	[illegible]	[illegible]	10.0006156	11.2740279	57
4	8.7283366	9.9993776	[illegible]	11.2710411	10.0006224	11.2716634	56
5	8.7306882	9.9993708	8.7313174	11.2686826	10.0006292	11.2693118	55
6	8.7330272	9.9993640	8.7336631	11.2663369	10.0006360	11.2669728	54
7	8.7353535	9.9993572	8.7359964	11.2640036	10.0006428	11.2646465	53
8	8.7376675	9.9993503	8.7383172	11.2616828	10.0006497	11.2623325	52
9	8.7399691	9.9993433	8.7406258	11.2593742	10.0006567	11.2600309	51
10	8.7422586	9.9993364	8.7429222	[illegible]	10.0006636	11.2577414	50
11	8.7445360	9.9993293	8.7452067	11.2547933	10.0006707	11.2554640	49
12	8.7468015	9.9993223	8.7474792	11.2525208	10.0006777	11.2531985	48
13	8.7490553	9.9993152	8.7497400	11.2502600	10.0006848	11.2509447	47
14	8.7512973	9.9993081	8.7519892	11.2480108	10.0006919	11.2487027	46
15	8.7535278	9.9993009	8.7542269	11.2457731	10.0006991	11.2464722	45
16	8.7557469	9.9992938	8.7564531	11.2435469	10.0007060	11.2442531	44
17	8.7579546	9.9992865	8.7586681	11.2413319	10.0007135	11.2420454	43
18	8.7601512	9.9992793	8.7608719	11.2391281	10.0007207	11.2398488	42
19	8.7623366	9.9992720	8.7630647	11.2369353	10.0007280	11.2376634	41
20	8.7645111	9.9992646	8.7652465	11.2347535	10.0007354	11.2354889	40
21	8.7666747	9.9992572	8.7674175	11.2325825	10.0007428	11.2333252	39
22	8.7688275	9.9992498	8.7695777	11.2304223	10.0007502	11.2311723	38
23	8.7709697	9.9992424	8.7717274	11.2282726	10.0007576	11.2290303	37
24	8.7731014	9.9992349	8.7738665	11.2261335	10.0007651	11.2268986	36
25	8.7752226	9.9992274	8.7759952	11.2240048	10.0007726	11.2247774	35
26	8.7773334	9.9992198	8.7781136	11.2218864	10.0007802	11.2226666	34
27	8.7794340	9.9992122	8.7802218	11.2197782	10.0007878	11.2205660	33
28	8.7815244	9.9992046	8.7823199	11.2176801	10.0007954	11.2184756	32
29	8.7836048	9.9991969	8.7844079	11.2155921	10.0008031	11.2163952	31
30	8.7856753	9.9991892	8.7864861	11.2135139	10.0008108	11.2143247	30
		Sine.		Tang		Secant	M

86 Degrees.

3 Degrees.

M	Sine.		Tang		Secant		
30	8.7856753	9.9991892	8.7864861	11.2135139	10.0008108	11.2143247	30
31	8.7877359	9.9991815	8.7885544	11.2114456	10.0008185	11.2122641	29
32	8.7897867	9.9991737	8.7906130	11.2093870	10.0008263	11.2102133	28
33	8.7918278	9.9991659	8.7926620	11.2073380	10.0008341	11.2081722	27
34	8.7938594	9.9991580	8.7947014	11.2052986	10.0008420	11.2061406	26
35	8.7958814	9.9991501	8.7967313	11.2032687	10.0008499	11.2041186	25
36	8.7978941	9.9991422	8.7987519	11.2012481	10.0008578	11.2021059	24
37	8.7998974	9.9991342	8.8007632	11.1992368	10.0008658	11.2001026	23
38	8.8018915	9.9991262	8.8027653	11.1972347	10.0008738	11.1981085	22
39	8.8038764	9.9991182	8.8047583	11.1952417	10.0008818	11.1961236	21
40	8.8058523	9.9991101	8.8067422	11.1932578	10.0008899	11.1941477	20
41	8.8078192	9.9991020	8.8087172	11.1912828	10.0008980	11.1921808	19
42	8.8097772	9.9990938	8.8106834	11.1893166	10.0009062	11.1902228	18
43	8.8117264	9.9990856	8.8126407	11.1873593	10.0009144	11.1882736	17
44	8.8136668	9.9990774	8.8145894	11.1854106	10.0009226	11.1863332	16
45	8.8155985	9.9990691	8.8165294	11.1834706	10.0009309	11.1844015	15
46	8.8175217	9.9990608	8.8184608	11.1815392	10.0009392	11.1824783	14
47	8.8194363	9.9990525	8.8203838	11.1796162	10.0009475	11.1805637	13
48	8.8213425	9.9990441	8.8222984	11.1777016	10.0009559	11.1786575	12
49	8.8232404	9.9990357	8.8242046	11.1757954	10.0009643	11.1767596	11
50	8.8251299	9.9990273	8.8261026	11.1738974	10.0009727	11.1748701	10
51	8.8270112	9.9990188	8.8279924	11.1720076	10.0009812	11.1729888	9
52	8.8288844	9.9990103	8.8298741	11.1701259	10.0009897	11.1711156	8
53	8.8307495	9.9990017	8.8317478	11.1682522	10.0009983	11.1692505	7
54	8.8326066	9.9989931	8.8336134	11.1663866	10.0010069	11.1673934	6
55	8.8345557	9.9989845	8.8354712	11.1645288	10.0010155	11.1655443	5
56	8.8362969	9.9989758	8.8373211	11.1626789	10.0010242	11.1637031	4
57	8.8381304	9.9989671	8.8391633	11.1608367	10.0010329	11.1618696	3
58	8.8399561	9.9989584	8.8409977	11.1590023	10.0010416	11.1600439	2
59	8.8417741	9.9989496	8.8428245	11.1571755	10.0010504	11.1582259	1
60	8.8435845	9.9989408	8.8446437	11.1553563	10.0010592	11.1564155	0
		Sine.		Tang.		Secant	M

86 Degrees.

A Table of Artificial Sines,

4 Degrees.

M	Sine		Tang		Secant		
0	8.8435845	9.9989408	8.8446437	11.1553563	10.0010592	11.1564155	60
1	8.8453874	9.9989319	8.8464554	11.1535446	10.0010681	11.1546126	59
2	8.8471827	9.9989230	8.8482597	11.1517403	10.0010770	11.1528173	58
3	8.8489707	9.9989141	8.8500566	11.1499434	10.0010859	11.1510293	57
4	8.8507512	9.9989052	8.8518461	11.1481539	10.0010948	11.1492488	56
5	8.8525245	9.9988962	8.8536283	11.1463717	10.0011038	11.1474755	55
6	8.8542905	9.9988871	8.8554034	11.1445966	10.0011129	11.1457095	54
7	8.8560493	9.9988780	8.8571713	11.1428287	10.0011220	11.1439507	53
8	8.8578010	9.9988689	8.8589321	11.1410679	10.0011311	11.1421990	52
9	8.8595457	9.9988598	8.8606859	11.1393141	10.0011402	11.1404543	51
10	8.8612833	9.9988506	8.8624327	11.1375673	10.0011494	11.1387167	50
11	8.8630139	9.9988414	8.8641725	11.1358275	10.0011586	11.1369861	49
12	8.8647376	9.9988321	8.8659055	11.1340945	10.0011679	11.1352624	48
13	8.8664545	9.9988228	8.8676317	11.1323683	10.0011772	11.1335455	47
14	8.8681646	9.9988135	8.8693511	11.1306489	10.0011865	11.1318354	46
15	8.8698680	9.9988041	8.8710638	11.1289362	10.0011959	11.1301320	45
16	8.8715646	9.9987947	8.8727699	11.1272301	10.0012053	11.1284354	44
17	8.8732546	9.9987853	8.8744694	11.1255306	10.0012147	11.1267454	43
18	8.8749381	9.9987758	8.8761623	11.1238377	10.0012242	11.1250619	42
19	8.8766150	9.9987663	8.8778487	11.1221513	10.0012337	11.1233850	41
20	8.8782854	9.9987567	8.8795286	11.1204714	10.0012433	11.1217146	40
21	8.8799493	9.9987471	8.8812022	11.1187978	10.0012529	11.1200507	39
22	8.8816069	9.9987375	8.8828694	11.1171306	10.0012625	11.1183931	38
23	8.8832581	9.9987278	8.8845303	11.1154697	10.0012722	11.1167419	37
24	8.8849031	9.9987181	8.8861850	11.1138150	10.0012819	11.1150969	36
25	8.8865418	9.9987084	8.8878334	11.1121666	10.0012916	11.1134582	35
26	8.8881743	9.9986986	8.8894757	11.1105243	10.0013014	11.1118257	34
27	8.8898007	9.9986888	8.8911119	11.1088881	10.0013112	11.1101993	33
28	8.8914209	9.9986790	8.8927420	11.1072580	10.0013210	11.1085791	32
29	8.8930351	9.9986691	8.8943660	11.1056340	10.0013309	11.1069649	31
30	8.8946433	9.9986591	8.8959842	11.1040158	10.0013409	11.1053567	30
		Sine		Tang		Secant	M

85 Degrees.

4 *Degrees.*

M	Sine.		Tang		Secant		
30	8.8946433	9.9986591	8.8959843	11.1040158	10.0013409	11.1053567	30
31	8.8962455	9.9986492	8.8975962	11.1024037	10.0013508	11.1037545	29
32	8.8978418	9.9986392	8.8992026	11.1007974	10.0013608	11.1021582	28
33	8.8994322	9.9986292	8.9008030	11.0991970	10.0013708	11.1005678	27
34	8.9010168	9.9986191	8.9023977	11.0976023	10.0013809	11.0989832	26
35	8.9025955	9.9986090	8.9039866	11.0960134	10.0013910	11.0974045	25
36	8.9041685	9.9985988	8.9055697	11.0944303	10.0014012	11.0958315	24
37	8.9057358	9.9985886	8.9071472	11.0928528	10.0014114	11.0942642	23
38	8.9072975	9.9985784	8.9087190	11.0912810	10.0014216	11.0927025	22
39	8.9088535	9.9985682	8.9102853	11.0897147	10.0014318	11.0911465	21
40	8.9104039	9.9985579	8.9118460	11.0881540	10.0014421	11.0895961	20
41	8.9119487	9.9985475	8.9134012	11.0865988	10.0014525	11.0880513	19
42	8.9134881	9.9985372	8.9149509	11.0850491	10.0014628	11.0865119	18
43	8.9150219	9.9985268	8.9164952	11.0835048	10.0014732	11.0849781	17
44	8.9165504	9.9985163	8.9180340	11.0819660	10.0014837	11.0834496	16
45	8.9180734	9.9985058	8.9195675	11.0804325	10.0014942	11.0819266	15
46	8.9195911	9.9984953	8.9210957	11.0789043	10.0015047	11.0804089	14
47	8.9211034	9.9984848	8.9226186	11.0773814	10.0015152	11.0788966	13
48	8.9226105	9.9984742	8.9241363	11.0758637	10.0015258	11.0773895	12
49	8.9241123	9.9984636	8.9256487	11.0743513	10.0015364	11.0758877	11
50	8.9256089	9.9984529	8.9271560	11.0728440	10.0015471	11.0743911	10
51	8.9271003	9.9984422	8.9286581	11.0713419	10.0015578	11.0728997	9
52	8.9285866	9.9984315	8.9301552	11.0698448	10.0015685	11.0714134	8
53	8.9300678	9.9984207	8.931647	11.0683529	10.0015793	11.0699322	7
54	8.9315439	9.9984099	8.9331340	11.0668660	10.0015901	11.0684561	6
55	8.9330150	9.9983990	8.9346160	11.0653840	10.0016010	11.0669850	5
56	8.9344811	9.9983881	8.9360929	11.0639071	10.0016119	11.0655189	4
57	8.9359422	9.9983772	8.9375650	11.0624350	10.0016228	11.0640578	3
58	8.9373983	9.9983663	8.9390321	11.0609679	10.0016337	11.0626017	2
59	8.9388496	9.9983553	8.9404944	11.0595056	10.0016447	11.0611504	1
60	8.9402960	9.9983442	8.9419518	11.0580482	10.0016558	11.0597040	0
		Sine.		Tang.		Secant	M

85 *Degrees.*

A Table of Artificial Sines,

5 *Degrees.*

M	Sine		Tang		Secant		
0	8.9402960	9.9983442	8.9419518	11.0580482	10.0016558	11 0 5970	60
1	8.9417376	9.9983332	8.9434044	11.0565956	10.0016668	11.0582624	59
2	8.9431743	9.9983220	8.9448523	11.0551477	10.0016780	11.0568257	58
3	8.9446063	9.9983109	8.9462954	11.0537046	10.0016891	11.0553937	57
4	8.9460235	9.9982997	8.9477338	11.0522662	10.0017003	11.0539665	56
5	8.9474561	9.9982885	8.9491676	11.0508324	10.0017115	11.0525439	55
6	8.9488739	9.9982772	8.9505967	11.0494033	10.0017228	11.0511261	54
7	8.9502871	9.9982660	8.9520211	11.0479789	10.0017340	11.0497129	53
8	8.9516957	9.9982546	8.9534410	11.0465590	10.0017454	11.0483043	52
9	8.9530996	9.9982433	8.9548564	11.0451436	10.0017[illegible]	[illegible]0469004	51
10	8.9544991	9.9982318	8.9562672	11.0437328	10.00[illegible]	[illegible]0455009	50
11	8.9558960	9.9982204	8.9576735	11.0423265	10.0017796	11.0441060	49
12	8.9572843	9.9982089	8.9590754	11.0409246	10.0017911	11.0427157	48
13	8.9586703	9.9981974	8.9604728	11.0395272	10.0018026	11.0413297	47
14	8.9600517	9.9981859	8.9618659	11.0381341	10.0018141	11.0399483	46
15	8.9614288	9.9981742	8.9632545	11.0367455	10.0018257	11.0385712	45
16	8.9628014	9.9981626	8.9646386	11.0353612	10.0018371	11.0371986	44
17	8.9641697	9.9981510	8.9660188	11.0339812	10.0018490	11.0358303	43
18	8.9655337	9.9981393	8.9673944	11.0326056	10.0018607	11.0344663	42
19	8.9668934	9.9981275	8.9687658	11.0312342	10.0018725	11.0331066	41
20	8.9682487	9.9981158	8.9701330	11.0298670	10.0018842	11.0317513	40
21	8.9695999	9.9981040	8.9714959	11.0285041	10.0018960	11.0304001	39
22	8.9709468	9.9980921	8.9728547	11.0271453	10.0019079	11.0290532	38
23	8.9722895	9.9980802	8.9742092	11.0257908	10.0019198	11.0277105	37
24	8.9736280	9.9980683	8.9755597	11.0244403	10.0019317	11.0263720	36
25	8.9749624	9.9980563	8.9769060	11.0230940	10.0019437	11.0250376	35
26	8.9762926	9.9980443	8.9782483	11.0217517	10.0019557	11.0237074	34
27	8.9776188	9.9980323	8.9795865	11.0204135	10.0019677	11.0223812	33
28	8.9789408	9.9980202	8.9809206	11.0190794	10.0019798	11.0210592	32
29	8.9802589	9.9980081	8.9822507	11.0177493	10.0019919	11.0197411	31
30	8.9815729	9.9979960	8.9835769	11.0164231	10.0020040	11.0184271	30
		Sine.		Tang		Secant	M

84 *Degrees.*

5 *Degrees.*

M	Sine		Tang		Secant		
30	8.9815720	9.9979960	8.9835769	11.0164231	10.0020040	11.0184271	30
31	8.9828820	9.9979838	8.9848991	11.0151009	10.0020162	11.0171171	29
32	8.9841880	9.9979716	8.9862173	11.0137827	10.0020284	11.0158111	28
33	8.9854910	9.9979594	8.9875317	11.0124683	10.0020407	11.0145090	27
34	8.9867891	9.9979470	8.9888421	11.0111579	10.0020530	11.0132109	26
35	8.9880834	9.9979347	8.9901487	11.0098513	10.0020653	11.0119166	25
36	8.9893737	9.9979223	8.9914514	11.0085489	10.0020777	11.0106263	24
37	8.9906602	9.9979099	8.9927503	11.0072497	10.0020901	11.0093398	23
38	8.9919429	9.9978975	8.9940454	11.0059546	10.0021025	11.0080572	22
39	8.99322[illegible]	[illegible]8850	8.9953367	11.0046633	10.0021150	11.0067783	21
40	8.99449[illegible]	[illegible]725	8.9966243	11.0033757	10.0021275	11.0055032	20
41	8.9957681	[illegible]78590	8.9979081	11.0020919	10.0021410	11.0042319	19
42	8.9970356	9.9978473	8.9991883	11.0008117	10.0021527	11.0029644	18
43	8.998299	9.9978347	9.0004647	10.9995353	10.0021653	11.0017006	17
44	8.9995595	9.9978220	9.0017375	10.9982625	10.0021780	11.0004405	16
45	9.0008160	9.9978093	9.0030066	10.9969934	10.0021907	10.9991840	15
46	9.0020687	9.9977966	9.0042721	10.9957279	10.0022034	10.9979313	14
47	9.0033179	9.9977838	9.0055340	10.9944660	10.0022162	10.9966821	13
48	9.0045634	9.9977710	9.0067924	10.9932076	10.0022290	10.9954366	12
49	9.0058053	9.9977582	9.0080471	10.9919529	10.0022418	10.9941947	11
50	9.0070436	9.9977453	9.0092984	10.9907016	10.0022547	10.9929564	10
51	9.0082784	9.9977323	9.0105461	10.9894539	10.0022677	10.9917216	9
52	9.0095096	9.9977194	9.0117903	10.9882097	10.0022806	10.9904904	8
53	9.0107374	9.9977064	9.0130310	10.9869690	10.0022936	10.9892626	7
54	9.0119616	9.9976933	9.0142682	10.9857318	10.0023067	10.9880384	6
55	9.0131823	9.9976803	9.0155021	10.9844979	10.0023197	10.9868177	5
56	9.0143996	9.9976672	9.0167325	10.9832675	10.0023328	10.9856004	4
57	9.0156135	9.9976540	9.0179594	10.9820406	10.0023460	10.9843865	3
58	9.0168238	9.9976408	9.0191831	10.9808169	10.0023592	10.9831761	2
59	9.0180309	9.9976276	9.0204033	10.9795967	10.0023724	10.9819691	1
60	9.0192346	9.9976143	9.0216202	10.9783798	10.0023857	10.9807654	0
		Sine.		Tang		Secant	M

84 *Degrees.*

A Table of Artificial Sines,

6 *Degrees.*

M	Sine.		Tang		Secant		
0	9.0192346	9.9976143	9.0216202	10.9783798	10.0023857	10.9807654	6
1	9.0204348	9.9976011	9.0228338	10.9771662	10.0023989	10.9795652	59
2	9.0216318	9.9975877	9.0240441	10.9769559	10.0024123	10.9783682	58
3	9.0228254	9.9975743	9.0252510	10.9747490	10.0024257	10.9771746	57
	9.0240157	9.9975609	9.0264548	10.9735452	10.0024391	10.9759843	56
5	9.0252027	9.9975475	9.0276552	10.9723448	10.0024525	10.9747973	55
6	9.0263865	9.9975340	9.0288524	10.9711476	10.0024660	10.9736135	54
7	9.0275669	9.9975205	9.0300464	10.9699536	10.0024795	10.9724331	53
8	9.0287442	9.9975069	9.0312373	10.9687627	10.0024931	10.9712558	52
9	9.0299182	9.9974933	9.0324249	10.9675751	10.0025067	10.9700818	51
10	9.0310890	9.9974797	9.0336093	10.9663907	10.0025203	10.9689110	50
11	9.0322567	9.9974660	9.0347906	10.9652094	10.0025340	10.9677433	40
2	9.0334212	9.9974523	9.0359688	10.9640312	10.0025477	10.9665788	48
13	9.0345825	9.9974386	9.0371439	10.9628561	10.0025614	10.9654175	47
14	9.0357407	9.9974248	9.0383159	10.9616841	10.0025752	10.9642593	46
15	9.0368958	9.9974110	9.0394848	10.9605152	10.0025890	10.9631042	45
16	9.0380477	9.9973971	9.0406506	10.9593494	10.0026029	10.9619523	44
17	9.0391966	9.9973833	9.0418134	10.9581866	10.0026167	10.9608034	43
18	9.0403424	9.9973693	9.0429731	10.9570269	10.0026307	10.9596576	42
19	9.0414852	9.9973554	9.0441299	10.9558701	10.0026446	10.9585148	41
20	9.0426249	9.9973414	9.0452836	10.9547164	10.0026586	10.9573751	40
21	9.0437617	9.9973273	9.0464643	10.9535657	10.0026727	10.9562383	39
22	9.0448954	9.9973132	9.0475821	10.9524179	10.0026868	10.9551046	38
23	9.0460261	9.9972991	9.0487270	10.9512730	10.0027009	10.9539739	37
24	9.0471538	9.9972850	9.0498689	10.9501311	10.0027150	10.9528462	36
25	9.0482786	9.9972708	9.0510078	10.9489922	10.0027292	10.9517214	35
26	9.0494005	9.9972566	9.0521439	10.9478561	10.0027434	10.9505995	34
27	9.0505194	9.9972423	9.0532771	10.9467229	10.0027577	10.9494806	33
28	9.0516354	9.9972280	9.0544074	10.9455926	10.0027720	10.9483646	32
29	9.0527485	9.9972137	9.0555349	10.9444651	10.0027863	10.9472515	31
30	9.0538588	9.9971993	9.0566595	10.9433405	10.0028007	10.9461412	30
		Sine.		Tang		Secant	M

83 *Degrees.*

6 *Degrees.*

M	Sine.		Tang		Secant		
30	9.0538588	9.9971993	9.0566595	10.9433405	10.0028007	10.9461412	30
31	9.0549661	9.9971849	9.0577813	10.9422187	10.0028151	10.9450339	29
32	9.0560706	9 9971704	9.0589002	10.9410998	10.0028296	10.9439294	28
33	9.0571723	9.9971559	9.0600164	10 9399836	10.0028441	10.9428377	27
34	9.0582711	9.9971414	9.0611297	10.9388703	10.0028586	10.9417289	26
35	9 0593672	9.9971268	9.0622403	10 9377597	10.0028732	10.9406328	25
36	9.0604604	9 9971122	9.0633482	10.9366518	10.0028878	10.9395496	24
37	9.0615509	9.9970976	9.0644533	10.9355467	10.0029024	10.9384491	23
38	9.0626386	9.9970829	9.0655556	10 9344444	10.0029171	10.9373614	22
39	9.0637235	9.9970682	9.0666553	10.9333447	10 0029318	10.9362765	21
40	9.0648057	9.9970535	9.0677522	10.9322478	10.0029465	10.9351943	20
41	9.0658852	9.9970387	9.0688465	10.9311535	10.0029613	10.9341148	19
42	9.0669619	9.9970239	9.0699381	10.9300619	10.0029761	10.9330381	18
43	9 0680360	9.9970090	9.0710270	10.9289730	10.0029910	10.9319640	17
44	9.0691074	9.9969041	9 0721133	10.9278867	10.0030959	10.9308926	16
45	9.0701761	9.9969702	9.0731969	10.9268031	10 0030208	10.9298239	15
46	9.0712421	9.9969642	9.0742779	10 9257221	10 0030358	10.9287579	14
47	9.0723055	9.9969482	9.0753563	10.9246437	10.0030508	10.9276945	13
48	9.0733663	9.9969342	9.0764321	10 9235679	10.0030658	10.9266337	12
49	9.0744244	9 9969191	9.0775053	10.9224947	10.0030809	10.9255756	11
50	9.0754799	9 9969040	9.0785760	10.9214240	10 0030960	10.9245201	10
51	9.0765329	9.9968888	9.0796441	10.9203559	10.0031112	10.9234671	9
52	9.0775832	9.9968736	9.0807096	10.9192094	10.0031264	10.9224168	8
53	9.0786310	9 9968584	9 0817726	10.9182274	10.0031416	10.9213690	7
54	9.0796762	9.9968431	9.0828341	10.9171669	10.0031569	10.9203238	6
55	9.0807189	9.9968278	9.0838911	10.9161089	10.0031722	10.9192811	5
56	9.0817590	9 9968125	9.0849466	10.9150534	10.0031875	10 9182410	4
57	9.0827966	9.9967971	9.0859996	10.9140004	10.0032029	10.9172034	3
58	9.0838317	9.9967817	9.0870501	10.9129499	10.0032183	10.9161683	2
59	9.0848643	9.9967662	9.0880981	10.9119019	10.0032338	10.9151357	1
60	9 0858945	9.9967507	9.0891438	10 9108562	10.0032493	10.9141055	0
		Sine.		Tang		Secant	M

83 *Degrees.*

A Table of Artificial Sines,

7 *Degrees.*

M	Sine.		Tang		Secant		
0	9.0858945	9.9967507	9.0891438	10.9108562	10.0032493	10.9141055	60
1	9.0869221	9.9967352	9.0901869	10.9098131	10.0032648	10.9130779	59
2	9.0879473	9.9967196	9.0912277	10.9087723	10.0032804	10.9120527	58
3	9.0889700	9.9967040	9.0922660	10.9077340	10.0032960	10.9110300	57
4	9.0899903	9.9966884	9.0933020	10.9066980	10.0033116	10.9100097	56
5	9.0910082	9.9966727	9.0943355	10.9056645	10.0033273	10.9089918	55
6	9.0920237	9.9966570	9.0953667	10.9046333	10.0033430	10.9079763	54
7	9.0930367	9.9966412	9.0963955	10.9036045	10.0033588	10.9069633	53
8	9.0940474	9.9966254	9.0974219	10.9025781	10.0033746	10.9059526	52
9	9.0950556	9.9966096	9.0984460	10.9015540	10.0033904	10.9049444	51
10	9.0960615	9.9965937	9.0994678	10.9005322	10.0034063	10.9039385	50
11	9.0970651	9.9965778	9.1004872	10.8995128	10.0034222	10.9029349	49
12	9.0980662	9.9965619	9.1015044	10.8984956	10.0034381	10.9019338	48
13	9.0990651	9.9965459	9.1025192	10.8974808	10.0034541	10.9009349	47
14	9.1000616	9.9965299	9.1035317	10.8964683	10.0034701	10.8999384	46
15	9.1010558	9.9965138	9.1045420	10.8954580	10.0034862	10.8989442	45
16	9.1020477	9.9964977	9.1055500	10.8944500	10.0035023	10.8979523	44
17	9.1030373	9.9964816	9.1065557	10.8934443	10.0035184	10.8969627	43
18	9.1040246	9.9964655	9.1075591	10.8924409	10.0035345	10.8959754	42
19	9.1050096	9.9964493	9.1085604	10.8914396	10.0035507	10.8949904	41
20	9.1059924	9.9964330	9.1095594	10.8904406	10.0035670	10.8940076	40
21	9.1069729	9.9964167	9.1105562	10.8894438	10.0035833	10.8930271	39
22	9.1079512	9.9964004	9.1115508	10.8884492	10.0035996	10.8920488	38
23	9.1089272	9.9963841	9.1125431	10.8874569	10.0036159	10.8910728	37
24	9.1099010	9.9963677	9.1135333	10.8864667	10.0036323	10.8900990	36
25	9.1108726	9.9963513	9.1145213	10.8854787	10.0036487	10.8891274	35
26	9.1118420	9.9963348	9.1155072	10.8844298	10.0036652	10.8881580	34
27	9.1128092	9.9963183	9.1164909	10.8835091	10.0036817	10.8871908	33
28	9.1137742	9.9963018	9.1174724	10.8825176	10.0036982	10.8862258	32
29	9.1147370	9.9962852	9.1184518	10.8815482	10.0037148	10.8852630	31
30	9.1156977	9.9962686	9.1194291	10.8805709	10.0037314	10.8843023	30
		Sine.		Tang		Secant	M

82 *Degrees.*

7 *Degrees.*

M	Sine.		Tang		Secant		
30	9.1156977	9.9962686	9.1194291	10.8805709	10.0037314	10.8843023	30
31	9.1166562	9.9962519	9.1204043	10.8795957	10.0037481	10.8833438	29
32	9.1176125	9.9962352	9.1213773	10.8786227	10.0037648	10.8823875	28
33	9.1185667	9.9962185	9.1223482	10.8776518	10.0037815	10.8814333	27
34	9.1195188	9.9962017	9.1233371	10.8766829	10.0037983	10.8804812	26
35	9.1204688	9.9961849	9.1242839	10.8757161	10.0038151	10.8795312	25
36	9.1214167	9.9961681	9.1252486	10.8747514	10.0038319	10.8785833	24
37	9.1223624	9.9961512	9.1262212	10.8737888	10.0038488	10.8776376	23
38	9.1233061	9.9961343	9.1271718	10.8728282	10.0038657	10.8766939	22
39	9.1242477	9.9961174	9.1281303	10.8718697	10.0038826	10.8757523	21
40	9.1251872	9.9961004	9.1290868	10.8709132	10.0038996	10.8748128	20
41	9.1261246	9.9960834	9.1300413	10.8699587	10.0039166	10.8738754	19
42	9.1270600	9.9960663	9.1309937	10.8690063	10.0039337	10.8729490	18
43	9.1279934	9.9960492	9.1319442	10.8680558	10.0039508	10.8720066	17
44	9.1289247	9.9960321	9.1328926	10.8671074	10.0039697	10.8710753	16
45	9.1298539	9.9960149	9.1338390	10.8661609	10.0039851	10.8701461	15
46	9.1307812	9.9959977	9.1347835	10.8652165	10.0040023	10.8692188	14
47	9.1317064	9.9959804	9.1357260	10.8642740	10.0040196	10.8682936	13
48	9.1326297	9.9959631	9.1366665	10.8633335	10.0040369	10.8673703	12
49	9.1335509	9.9959458	9.1376051	10.8623949	10.0040542	10.8664491	11
50	9.1344702	9.9959284	9.1385417	10.8614583	10.0040716	10.8655298	10
51	9.1353875	9.9959111	9.1394764	10.8605236	10.0040889	10.8646125	9
52	9.1363028	9.9958936	9.1404092	10.8595908	10.0041064	10.8636972	8
53	9.1372161	9.9958761	9.1413400	10.8586600	10.0041239	10.8627839	7
54	9.1381275	9.9958586	9.1422689	10.8577311	10.0041414	10.8618725	6
55	9.1390370	9.9958411	9.1431959	10.8568041	10.0041589	10.8609630	5
56	9.1399445	9.9958235	9.1441210	10.8558790	10.0041765	10.8600555	4
57	9.1408501	9.9958059	9.1450442	10.8549558	10.0041941	10.8591499	3
58	9.1417537	9.9957882	9.1459655	10.8540345	10.0042118	10.8582463	2
59	9.1426555	9.9957705	9.1468850	10.8531150	10.0042295	10.8573445	1
60	9.1435553	9.9957528	9.1478025	10.8521975	10.0042472	10.8564447	0
		Sine.		Tang.		Secant	M

82 *Degrees.*

A Table of Artificial Sines,

8 Degrees.

M	Sine.		Tang		Secant		
0	9.1435553	9.9957528	9.1478025	10.8521975	10.0042472	10 8564447	60
1	9.1444532	9.9957350	9.1487182	10.8512818	10.0042650	10.8555468	59
2	9.1453493	9.9957172	9.1496321	10.8500679	10.0042828	10.8546507	58
3	9.1462435	9.9956993	9.1505441	10.8494559	10.0043007	10.8537565	57
4	9.1471358	9.9956815	9.1514543	10.8485457	10.0043185	10.8528642	56
5	9.1480262	9.9956635	9.1523627	10.8476373	10.0043365	10.8519738	55
6	9.1489148	9.9956456	9.1532692	10.8467308	10.0043544	10.8510852	54
7	9.1498015	9.9956276	9.1541739	10.8458261	10.0043724	10.8501985	53
8	9.1506864	9.9956095	9.1550769	10.8449231	10.0043905	10.8493136	52
9	9.1515694	9.9955915	9.1559780	10.8440220	10.0044085	10.8484306	51
10	9.1524507	9.9955734	9.1568873	10.8431227	10.0044266	10.8475493	50
11	9.1533301	9.9955552	9.1577748	10.8422252	10.0044448	10.8466699	49
12	9.1542076	9.9955370	9.1586706	10.8413294	10.0044630	10.8457924	48
13	9.1550834	9.9955188	9.1595646	10.8404354	10.0044812	10.8449166	47
14	9.1559574	9.9955005	9.1604569	10.8395431	10.0044995	10.8440426	46
15	9.1568296	9.9954822	9.1613473	10.8386527	10.0045178	10.8431704	45
16	9.1577000	9.9954639	9.1622361	10.8377639	10.0045361	10.8423000	44
17	9.1585686	9.9954455	9.1631231	10.8368769	10.0045545	10.8414314	43
18	9.1594354	9.9954271	9.1640083	10.8359917	10.0045729	10.8405646	42
19	9.1603005	9.9954087	9.1648919	10.8351081	10.0045913	10.8396995	41
20	9.1611639	9.9953902	9.1657737	10.8342263	10.0046098	10.8388361	40
21	9.1620254	9.9953717	9.1666538	10.8333462	10.0046283	10.8379745	39
22	9.1628853	9.9953531	9.1675322	10.8324678	10.0046469	10.8371147	38
23	9.1637434	9.9953345	9.1684989	10.8315911	10.0046655	10.8362566	37
24	9.1645998	9.9953159	9.1692839	10.8307161	10.0046841	10.8354002	36
25	9.1654544	9.9952972	9.1701572	10.8298428	10.0047028	10.8345456	35
26	9.1663074	9.9952785	9.1710289	10.8289711	10.0047215	10.8336926	34
27	9.1671586	9.9952597	9.1718989	10.8281011	10.0047403	10.8328414	33
28	9.1680082	9.9952409	9.1727672	10.8272328	10.0047591	10.8319919	32
29	9.1688559	9.9952221	9.1736338	10.8263662	10.0047779	10.8311441	31
30	9.1697021	9.9952033	9.1744988	10.8255012	10.0047967	10.8302979	30
		Sine.		Tang		Secant	M

81 Degrees.

8 Degrees.

M	Sine.		Tang		Secant		
30	9.1697021	9.9952033	9.1744988	10.8255012	10.0047967	10 8302979	30
31	9.1705465	9.9951844	9.1753622	10.8246378	10.0048156	10.8294534	29
32	9.1713893	9.9951654	9.1762239	10.8237761	10.0048346	10.8286107	28
33	9.1722305	9.9951464	9.1770840	10.8229160	10.0048536	10.8277695	27
34	9.1730699	9.9951274	9.1779425	10.8220575	10.0048726	10.8269301	26
35	9.1739077	9.9951084	9.1787993	10.8212007	10.0048916	10.8260923	25
36	9.1747439	9 9950893	9.1796546	10.8203454	10.0049107	10.8252561	24
37	9.1755784	9.9950702	9.1805082	10.8194918	10.0049298	10.8244216	23
38	9.1764112	9.9950510	9.1813602	10.8186398	10.0049490	10.8235888	22
39	9.1772425	9.9950318	9.1822106	10.8177894	10.0049682	10.8227575	21
40	9.1780721	9.9950126	9.1830595	10.8169405	10.0049874	10.8219279	20
41	9.1789001	9.9949933	9.1839068	10.8160932	10.0050067	10 8210999	19
42	9.1797265	9.9949740	9.1847525	10.8152475	10.0050260	10.8202735	18
43	9.1805512	9.9949546	9.1855966	10.8144034	10.0050454	10 8194888	17
44	9.1813744	9.9949352	9.1864392	10.8135608	10.0050648	10 8186256	16
45	9.1821960	9.9949158	9.1872802	10.8127198	10.0050842	10.8178040	15
46	9.1830160	9.9948964	9.1881196	10.8118804	10.0051036	10.8169840	14
47	9.1838344	9.9948769	9.1889575	10.8110425	10.0051231	10.8161656	13
48	9.1846512	9.9948573	9.1897939	10.8102061	10.0051427	10.8153488	12
49	9.1854665	9.9948377	9.1906287	10.8093713	10.0051623	10.8145335	11
50	9.1862802	9.9948181	9.1914621	10.8085379	10.0051819	10.8137199	10
51	9.1870923	9.9947985	9.1922939	10.8077061	10.0052015	10 8129077	9
52	9.1879029	9.9947788	9.1931241	10.8068759	10 0052212	10.8120971	8
53	9.1887120	9.9947591	9.1939529	10.8060471	10.0052409	10.8112880	7
54	9.1895195	9.9947393	9.1947802	10.8052198	10.0052607	10.8104805	6
55	9.1903254	9.9947193	9.1956059	10.8043941	10.0052805	10.8096746	5
56	9.1911299	9.9946997	9.1964302	10.8035698	10.0053003	10.8088701	4
57	9.1919328	9.9946798	9.1972530	10.8027470	10.0053202	10.8080672	3
58	9.1927342	9.9946599	9.1980743	10.8019257	10.0053401	10.8072658	2
59	9.1935341	9.9946399	9.1988942	10.8011059	10.0053601	10.8064659	1
60	9.1943324	9 9946199	9.1997125	10.8002875	10.0053801	10.8056676	0
		Sine.		Tang.		Secant	M

81 Degrees.

A Table of Artificial Sines,

9 Degrees.

M	Sine		Tang		Secant		
0	9.1943324	9.9946199	9.1997125	10.8002075	10.0053601	10.8056676	60
1	9.1951293	9.9945999	9.2005294	10.7994706	10.0054001	10.8048707	59
2	9.1959247	9.9945798	9.2013449	10.7986551	10.0054202	10.8040753	58
3	9.1967186	9.9945597	9.2021588	10.7978411	10.0054403	10.8032814	57
4	9.1975110	9.9945396	9.2029714	10.7970286	10.0054604	10.8024890	56
5	9.1983019	9.9945194	9.2037825	10.7962175	10.0054806	10.8016981	55
6	9.1990913	9.9944992	9.2045922	10.7954078	10.0055008	10.8009087	54
7	9.1998793	9.9944789	9.2054004	10.7945996	10.0055211	10.8001207	53
8	9.2006658	9.9944587	9.2062072	10.7937928	10.0055413	10.7993342	52
9	9.2014509	9.9944383	9.2070126	10.7929874	10.0055617	10.7985491	51
10	9.2022345	9.9944180	9.2078165	10.7921835	10.0055820	10.7977655	50
11	9.2030167	9.9943975	9.2086191	10.7913809	10.0056025	10.7969833	49
12	9.2037974	9.9943771	9.2094203	10.7905797	10.0056229	10.7962026	48
13	9.2045766	9.9943566	9.2102200	10.7897800	10.0056434	10.7954234	47
14	9.2053545	9.9943361	9.2110184	10.7889816	10.0056639	10.7946455	46
15	9.2061309	9.9943156	9.2118153	10.7881847	10.0056844	10.7938691	45
16	9.2069059	9.9942950	9.2126109	10.7873891	10.0057050	10.7930941	44
17	9.2076795	9.9942743	9.2134051	10.7865949	10.0057227	10.7923205	43
18	9.2084516	9.9942537	9.2141980	10.7858020	10.0057463	10.7915484	42
19	9.2092224	9.9942330	9.2149894	10.3850106	10.0057670	10.7907776	41
20	9.2099917	9.9942122	9.2157795	10.7842205	10.0057878	10.7900083	40
21	9.2107597	9.9941914	9.2165683	10.7834317	10.0058086	10.7892403	39
22	9.2115263	9.9941706	9.2173556	10.7826444	10.0058294	10.7884737	38
23	9.2122914	9.9941498	9.2181417	10.7818583	10.0058502	10.7877086	37
24	9.2130552	9.9941289	9.2189264	10.7810736	10.0058711	10.7869448	36
25	9.2138176	9.9941079	9.2197097	10.7802903	10.0058921	10.7861824	35
26	9.2145787	9.9940870	9.2204917	10.7795083	10.0059130	10.7854213	34
27	9.2153384	9.9940659	9.2212724	10.7787276	10.0059341	10.7846616	33
28	9.2160967	9.9940449	9.2220518	10.7779482	10.0059551	10.7839033	32
29	9.2168536	9.9940238	9.2228298	10.7771702	10.0059762	10.7831464	31
30	9.2176092	9.9940027	9.2236065	10.7763935	10.0059973	10.7823908	30
		Sine.		Tang		Secant	M

80 Degrees.

9 *Degrees.*

M	Sine.		Tang		Secant		
30	9.2176092	9.9940027	9.2236065	10.7763935	10.0050973	10.7823908	30
31	9.2183635	9.9939815	9.2243819	10.7756181	10.0060185	10.7816365	29
32	9.2191164	9.9939603	9.2251561	10.7748439	10.0060397	10.7808836	28
33	9.2198680	9.9939391	9.2259289	10.7740711	10.0060609	10.7801320	27
34	9.2206182	9.9939178	9.2267004	10.7732996	10.0060822	10.7793818	26
35	9.2213671	9.9938965	9.2274706	10.7725294	10.0061035	10.7786329	25
36	9.2221147	9.9938752	9.2282395	10.7717605	10.0061248	10.7778853	24
37	9.2228609	9.9938538	9.2290071	10.7709929	10.0061462	10.7771391	23
38	9.2236059	9.9938324	9.2297735	10.7702265	10.0061676	10.7763941	22
39	9.2243495	9.9938109	9.2305386	10.7694614	10.0061891	10.7756505	21
40	9.2250918	9.9937894	9.2313024	10.7686976	10.0062106	10.7749082	20
41	9.2258328	9.9937679	9.2320650	10.7679350	10.0062321	10.7741672	19
42	9.2265725	9.9937463	9.2328262	10.7671738	10.0062537	10.7734275	18
43	9.2272110	9.9937247	9.2335863	10.7664137	10.0062753	10.7726890	17
44	9.2280481	9.9937030	9.2343451	10.7656549	10.0062970	10.7719519	16
45	9.2287839	9.9936813	9.2351026	10.7648974	10.0063187	10.7712161	15
46	9.2295185	9.9936596	9.2358589	10.7641411	10.0063404	10.7704815	14
47	9.2302518	9.9936378	9.2366139	10.7633861	10.0063622	10.7697482	13
48	9.2309838	9.9936160	9.2373678	10.7626322	10.0063840	10.7690162	12
49	9.2317145	9.9935942	9.2381203	10.7618797	10.0064058	10.7682855	11
50	9.2324440	9.9935723	9.2388717	10.7611283	10.0064277	10.7675560	10
51	9.2331722	9.9935504	9.2396218	10.7603782	10.0064496	10.7668278	9
52	9.2338992	9.9935285	9.2403708	10.7596292	10.0064715	10.7661008	8
53	9.2346249	9.9935065	9.2411185	10.7588815	10.0064935	10.7653751	7
54	9.2353494	9.9934844	9.2418650	10.7581350	10.0065156	10.7646506	6
55	9.2360726	9.9934624	9.2426103	10.7573897	10.0065376	10.7639274	5
56	9.2367946	9.9934403	9.2433543	10.7566457	10.0065597	10.7632054	4
57	9.2375153	9.9934181	9.2440972	10.7559028	10.0065819	10.7624847	3
58	9.2382349	9.9933959	9.2448389	10.7551611	10.0066041	10.7617651	2
59	9.2389532	9.9933737	9.2455794	10.7544206	10.0066263	10.7610468	1
60	9.2396702	9.9933515	9.2463188	10.7536812	10.0066485	10.7603298	0
		Sine.		Tang		Secant	M

80 *Degrees.*

A Table of Artificial Sines,

10 *Degrees.*

M	Sine.		Tang		Secant		
0	9.2396702	9.9933515	9.2463188	10.7536812	10.0066485	10.7603298	60
1	9.2403861	9.9933292	9.2470569	10.7529431	10.0066708	10.7596139	59
2	9.2411007	9.9933068	9.2477939	10.7522061	10.0066932	10.7588993	58
3	9.2418141	9.9932845	9.2485297	10.7514703	10.0067155	10.7581859	57
4	9.2425264	9.9932621	9.2492643	10.7507357	10.0067379	10.7574736	56
5	9.2432374	9.9932396	9.2499978	10.7500022	10.0067604	10.7567626	55
6	9.2439472	9.9932171	9.2507301	10.7492699	10.0067829	10.7560528	54
7	9.2446558	9 9931946	9.2514612	10.7485388	10.0068054	10.7553442	53
8	9.2453632	9.9931720	9.2521912	10.7478088	10.0068280	10.7546368	52
9	9.2460695	9.9931494	9.2529200	10.7470800	10.0068506	10.7539305	51
10	9.2467746	9.9931268	9.2536477	10.7463523	10.0068732	10.7532254	50
11	9.2474784	9.9931041	9.2543743	10.7456257	10.0068959	10.7525216	49
12	9.2481811	9.9930814	9.2550997	10.7449003	10.0069186	10.7518189	48
13	9.2488817	9.9930587	9.2558240	10.7441760	10.0069413	10.7511173	47
14	9.2495830	9.9930359	9.2565472	10.7434528	10.0069641	10.7504170	46
15	9.2502822	9.9930131	9.2572692	10.7427308	10.0069869	10.7497178	45
16	9.2509803	9.9929902	9.2579901	10.7420099	10.0070098	10.7490197	44
17	9.2516772	9.9929673	9.2587099	10.7412901	10.0070327	10.7483228	43
18	9.2523729	9.9929444	9.2594285	10.7405715	10.0070556	10.7476271	42
19	9.2530675	9.9929214	9.2601461	10.7398539	10.0070786	10.7469325	41
20	9.2537609	9.9928984	9.2608625	10.7391375	10.0071016	10.7462391	40
21	9.2544532	9.9928753	9.2615779	10.7384221	10.0071247	10.7455468	39
22	9.2551444	9.9928522	9.2622921	10.7377079	10.0071478	10.7448556	38
23	9.2558344	9.9928291	9.2630053	10.7369947	10.0071709	10.7441656	37
24	9.2565233	9.9928059	9.2637173	10.7362827	10.0071941	10.7434767	36
25	9.2572110	9.9927827	9.2644283	10.7355717	10.0072173	10.7427890	35
26	9.2578977	9.9927595	9.2651382	10.7348618	10.0072405	10.7421023	34
27	9.2585832	9.9927362	9.2658470	10.7341530	10.0072638	10.7414168	33
28	9.2592676	9.9927129	9.2665547	10.7334453	10.0072871	10.7407324	32
29	9.2599509	9.9926895	9.2672613	10.7327387	10.0073105	10.7400491	31
30	9.2606330	9.9926661	9.2679669	10.7320331	10.0073339	10.7393670	30
		Sine.		Tang		Secant	M

79 *Degrees.*

10 *Degrees.*

M	Sine.		Tang		Secant		
30	9.2606330	9.9926661	9.2679669	10.7320331	10.0073339	10.7393670	30
31	9.2613141	9.9926427	9.2686714	10.7313286	10.0073573	10.7386859	29
32	9.2619941	9.9926192	9.2693749	10.7306251	10.0073808	10.7380059	28
33	9.2626729	9.9925957	9.2700772	10 7299228	10.0074043	10.7373271	27
34	9.2633507	9.9925722	9.2707786	10.7292214	10.0074278	10.7366493	26
35	9.2640274	9.9925486	9.2714788	10 7285212	10.0074514	10.7359729	25
36	9.2647030	9 9925250	9.2721780	10.7278220	10.0074750	10.7352970	24
37	9.2653775	9.9925013	9.2728762	10.7271238	10.0074987	10.7346225	23
38	9.2660509	9.9924776	9.2735733	10 7264267	10.0075224	10.7339491	22
39	9.2667232	9.9924539	9.2742694	10.7257306	10.0075461	10.7332768	21
40	9.2673945	9.9924301	9.2749644	10.7250356	10.0075699	10.7326055	20
41	9.2680647	9.9924063	9.2756584	10.7243416	10.0075937	10.7319353	19
42	9.2687338	9.9923824	9.2763514	10.7236486	10.0076176	10.7312662	18
43	9.2694019	9.9923585	9.2770434	10.7229566	10.0076415	10.7305981	17
44	9.2700689	9.9923346	9.2777343	10.7222657	10.0076654	10.7299311	16
45	9.2707348	9.9923106	9.2784242	10.7215758	10.0076894	10.7292652	15
46	9.2713997	9 9922866	9.2791130	10.7208869	10.0077134	10.7286003	14
47	9.2720635	9.9922626	9.2798009	10.7201991	10.0077374	10.7279365	13
48	9.2727263	9.9922385	9.2804878	10 7195122	10.0077615	10.7272737	12
49	9.2733880	9 9922144	9.2811736	10.7188264	10.0077856	10.7266120	11
50	9.2740487	9.9921902	9.2818585	10.7181415	10.0078098	10.7259513	10
51	9.2747083	9.9921660	9.2825423	10.7174577	10.0078340	10.7252917	9
52	9.2753669	9.9921418	9.2832251	10.7167749	10.0078582	10.7246331	8
53	9.2760245	9 9921175	9.2839069	10.7160930	10.0078825	10.7239755	7
54	9.2766811	9.9920932	9.2845878	10.7154122	10.0079068	10.7233189	6
55	9.2773366	9.9920689	9.2852677	10.7147323	10.0079311	10.7226634	5
56	9.2779911	9 9920445	9.2859466	10.7140534	10.0079555	10.7220089	4
57	9.2786445	9.9920201	9.2866245	10.7133755	10.0079799	10.7213555	3
58	9.2792970	9.9919956	9.2873014	10.7126986	10.0080044	10.7207030	2
59	9.2799484	9.9919711	9.2879773	10.7120227	10.0080289	10.7200516	1
60	9.2805988	9.9919466	9.2886523	10 7113477	10.0080534	10.7194012	0
		Sine.		Tang		Secant	M

79 *Degrees.*

A Table of Artificial Sines,

11 Degrees.

M	Sine.		Tang		Secant		
0	9.2805988	9.9919466	9.2886523	10.7113477	10.0080534	10.7194012	60
1	9.2812483	9.9919220	9.2892363	10.7106737	10.0080780	10.7187517	59
2	9.2818967	9.9918974	9.2899993	10.7100007	10.0081026	10.7181033	58
3	9.2825441	9.9918727	9.2906713	10.7093287	10.0081273	10.7174559	57
4	9.2831905	9.9918480	9.2913424	10.7086576	10.0081520	10.7168095	56
5	9.2838359	9.9918233	9.2920126	10.7079874	10.0081767	10.7161641	55
6	9.2844803	9.9917986	9.2926817	10.7073183	10.0082014	10.7155197	54
7	9.2851237	9.9917737	9.2933500	10.7066500	10.0082263	10.7148763	53
8	9.2857661	9.9917489	9.2940172	10.7059828	10.0082511	10.7142339	52
9	9.2864076	9.9917240	9.2946836	10.7053164	10.0082760	10.7135924	51
10	9.2870480	9.9916991	9.2953489	10.7046511	10.0083009	10.7129523	50
11	9.2876875	9.9916741	9.2960134	10.7039866	10.0083259	10.7123125	49
12	9.2883260	9.9916492	9.2966769	10.7033231	10.0083508	10.7116840	48
13	9.2889636	9.9916241	9.2973395	10.7026605	10.0083759	10.7110364	47
14	9.2896001	9.9915990	9.2980011	10.7019989	10.0084010	10.7103999	46
15	9.2902357	9.9915739	9.2986618	10.7013382	10.0084261	10.7097643	45
16	9.2908704	9.9915488	9.2993216	10.7006784	10.0084512	10.7091296	44
17	9.2915040	9.9915236	9.2999804	10.7000196	10.0084764	10.7084960	43
18	9.2921367	9.9914984	9.3006383	10.6993617	10.0085016	10.7078633	42
19	9.2927685	9.9914731	9.3012954	10.6987046	10.0085269	10.7072315	41
20	9.2933993	9.9914478	9.3019514	10.6980486	10.0085522	10.7066007	40
21	9.2940291	9.9914225	9.3026066	10.6973934	10.0085775	10.7059709	39
22	9.2946580	9.9913717	9.3032609	10.6967391	10.0086029	10.7053420	38
23	9.2952859	9.9913317	9.3039143	10.6960857	10.0086283	10.7047141	37
24	9.2959129	9.9913462	9.3045667	10.6954333	10.0086538	10.7040871	36
25	9.2965390	9.9913207	9.3052183	10.6947817	10.0086793	10.7034610	35
26	9.2971641	9.9912952	9.3058689	10.6941311	10:0087048	10.7028359	34
27	9.2977883	9.9912696	9.3065187	10.6934813	10.0087304	10.7022117	33
28	9.2984116	9.9912440	9.3071675	10.6928325	10.0087560	10.7015884	32
29	9.2990339	9.9912184	9.3078155	10.6921845	10.0087816	10.7009661	31
30	9.2996553	9.9911927	9.3084626	10.6915374	10.0088073	10.7003447	30
		Sine.		Tang		Secant	M

78 Degrees.

11 *Degrees.*

M	Sine.		Tang		Secant		
30	9.2996553	9.9911927	9.3084626	10.6915374	10.0088073	10.7003447	30
31	9.3002758	9.9911670	9.3091088	10.6908912	10.0088330	10.6997242	29
32	9.3008953	9.9911412	9.3097541	10.6902459	10.0088588	10.6991047	28
33	9.3015140	9.9911154	9.3103985	10.6896015	10.0088846	10.6984860	27
34	9.3021317	9.9910896	9.3110421	10.6889579	10.0089104	10.6978683	26
35	9.3027485	9.9910637	9.3116848	10.6883152	10.0089363	10.6972515	25
36	9.3033644	9.9910378	9.3123266	10.6876734	10.0089622	10.6966356	24
37	9.3039794	9.9910119	9.3129675	10.6870325	10.0089881	10.6960206	23
38	9.3045934	9.9909859	9.3136076	10.6863924	10.0090141	10.6954066	22
39	9.3052066	9.9909598	9.3142468	10.6857532	10.0090402	10.6947934	21
40	9.3058189	9.9909338	9.3148851	10.6851149	10.0090662	10.6941811	20
41	9.3064303	9.9909077	9.3155226	10.6844774	10.0090923	10.6935697	19
42	9.3070407	9.9908815	9.3161592	10.6838408	10.0091185	10.6929593	18
43	9.3076503	9.9908553	9.3167950	10.6832050	10.0091447	10.6923497	17
44	9.3082590	9.9908291	9.3174299	10.6825701	10.0091709	10.6917410	16
45	9.3088668	9.9908029	9.3180640	10.6819360	10.0091971	10.6911332	15
46	9.3094737	9.9907766	9.3186972	10.6813028	10.0092234	10.6905263	14
47	9.3100798	9.9907502	9.3193295	10.6806705	10.0092498	10.6899202	13
48	9.3106849	9.9907239	9.3199611	10.6800389	10.0092761	10.6893151	12
49	9.3112892	9.9906974	9.3205918	10.6794082	10.0093026	10.6887108	11
50	9.3118926	9.9906710	9.3212216	10.6787784	10.0093290	10.6881074	10
51	9.3124951	9.9906445	9.3218506	10.6781494	10.0093555	10.6875049	9
52	9.3130968	9.9906180	9.3224788	10.6775212	10.0093820	10.6869032	8
53	9.3136976	9.9905914	9.3231061	10.6768939	10.0094086	10.6863024	7
54	9.3142975	9.9905648	9.3237327	10.6762673	10.0094352	10.6857025	6
55	9.3148965	9.9905382	9.3243584	10.6756416	10.0094618	10.6851035	5
56	9.3154947	9.9905115	9.3249832	10.6750168	10.0094885	10.6845053	4
57	9.3160921	9.9904848	9.3256073	10.6743927	10.0095152	10.6839079	3
58	9.3166885	9.9904580	9.3262305	10.6737695	10.0095420	10.6833115	2
59	9.3172841	9.9904312	9.3268529	10.6731471	10.0095688	10.6827159	1
60	9.3178789	9.9904044	9.3274745	10.6725255	10.0095956	10.6821211	0
		Sine.		Tang.		Secant	M

78 *Degrees.*

A Table of Artificial Sines,

12 *Degrees.*

M	Sine.		Tang		Secant		
0	9.3178789	9.9904044	9.3274745	10.6725255	10.0095956	10 6821211	60
1	9.3184728	9.9903775	9.3280953	10.6719047	10.0096225	10.6815272	59
2	9.3190659	9.9903506	9.3287153	10.6712847	10.0096494	10.6809341	58
3	9.3196581	9.9903237	9.3293345	10.6706655	10.0096763	10.6803419	57
4	9.3202495	9.9902967	9.3299528	10.6700472	10.0097033	10.6797505	56
5	9.3208400	9.9902697	9.3305704	10.6699426	10.0097303	10.6791600	55
6	9.3214297	9.9902426	9.3311872	10.6688128	10.0097574	10.6785703	54
7	9.3220186	9.9902155	9.3318031	10.6681969	10.0097845	10.6779814	53
8	9.3226066	9.9901883	9.3324183	10.6675817	10.0098117	10.6773934	52
9	9.3231938	9.9901612	9.3330327	10.6669673	10.0098388	10.6768062	51
10	9.3237802	9.9901339	9.3336463	10.6663537	10.0098661	10.6762598	50
11	9.3243657	9.9901067	9.3342591	10.6657409	10.0098933	10.6756343	49
12	9.3249505	9.9900794	9.3348711	10.6651289	10.0099206	10.6750495	48
13	9.3255344	9.9900521	9.3354823	10.6645177	10.0099479	10.6744656	47
14	9.3261174	9.9900247	9.3360927	10.6639073	10.0099753	10.6738826	46
15	9.3266997	9.9899973	9.3367024	10.6632967	10.0100027	10.6733003	45
16	9.3272811	9.9899698	9.3373113	10.6626887	10.0100302	10.6727189	44
17	9.3278617	9.9899423	9.3379194	10.6620806	10.0100577	10.6721383	43
18	9.3284416	9.9899148	9.3385267	10.6614733	10.0100852	10.6715584	42
19	9.3290206	9.9898873	9.3391333	10.6608667	10.0101127	10.6709794	41
20	9.3295988	9.9898597	9.3397391	10.6602609	10.0101403	10.6704012	40
21	9.3301761	9.9898320	9.3403441	10 6596559	10.0101690	10.6698259	39
22	9.3307527	9.9898043	9.3409484	10.6590516	10.0101957	10.6692473	38
23	9.3313285	9.9897766	9.3415519	10.6584481	10.0102234	10 6686715	37
24	9.3319035	9.9897489	9.3421546	10.6578454	10.0102511	10.6680965	36
25	9.3324777	9.9897211	9.3427566	10.6572434	10.0102789	10.6675223	35
26	9.3330511	9.9896932	9.3433578	10.6566422	10.0103068	10.6669489	34
27	9.3336237	9.9896654	9.3439583	10.6560417	10.0103346	10.6663763	33
28	9.3341955	9.9896374	9.3445580	10.6554420	10.0103626	10.6658045	32
29	9.3347665	9.9896095	9.3451570	10.6548430	10.0103905	10.6652335	31
30	9.3353368	9.9895815	9.3457552	10.6542448	10.0104185	10.6646632	30
		Sine.		Tang		Secant	M

77 *Degrees.*

12 *Degrees.*

M	Sine.		Tang		Secant		
30	9.3353368	9.9895815	9.3457552	10.6542448	10.0104185	10 6646632	30
31	9.3359062	9.9895535	9.3463527	10.6536473	10.0104465	10.6640938	29
32	9.3364749	9.9895254	9.3469494	10.6530506	10.0104746	10.6635251	28
33	9.3370428	9.9894973	9.3475454	10.6524546	10.0105027	10.6629572	27
34	9.3376099	9.9894692	9.3481407	10.6518593	10.0105308	10.6623901	26
35	9.3381762	9.9894410	9.3487352	10.6512648	10.0105590	10.6618274	25
36	9.3387418	9 9894128	9.3493290	10.6506710	10.0105872	10.6612582	24
37	9.3393065	9.9893845	9.3499220	10.6500780	10 0106155	10.6606935	23
38	9.3398706	9.9893562	9.3505143	10.6494857	10.0106438	10.6601294	22
39	9.3404338	9.9893279	9.3511059	10.6488941	10.0106721	10.6595662	21
40	9 3409963	9.9892995	9.3516968	10.6483032	10.0107005	10.6590037	20
41	9.3415580	9.9892711	9.3522869	10.6477131	10 0107289	10.6584420	19
42	9.3421190	9.9892427	9.3528763	10.6471237	10.0107573	10.6578810	18
43	9.3426792	9.9892142	9.3534650	10.6465350	10.0107858	10 6573208	17
44	9.3432386	9.9891856	9.3540530	10.6459470	10 0108144	10 6567614	16
45	9.3437973	9.9891571	9.3546402	10.6453598	10.0108429	10.6562027	15
46	9.3443552	9.9891285	9.3552267	10.6447733	10.0108716	10.6556448	14
47	9.3449124	9.9890998	9.3558126	10.6441874	10.0109002	10.6550876	13
48	9.3454688	9.9890711	9.3563977	10.6436023	10.0109289	10.6545312	12
49	9.3460245	9.9890424	9.3569821	10.6430179	10.0109576	10.6539755	11
50	9.3465794	9.9890137	9.3575658	10.6424342	10.0109863	10.6534206	10
51	9.3471336	9.9889849	9.3581487	10.6418513	10.0110151	10.6528664	9
52	9.3476870	9.9889560	9.3587310	10.6412690	10.0110440	10.6523130	8
53	9.3482397	9.9889271	9.3593126	10.6406874	10.0110729	10.6517603	7
54	9.3487917	9.9888982	9.3598935	10.6401065	10.0111018	10.6512083	6
55	9.3493429	9.9888693	9.3604736	10.6395264	10.0111307	10.6506561	5
56	9.3498934	9.9888403	9.3610531	10.6389469	10.0111597	10.6501066	4
57	9.3504432	9.9888113	9.3616319	10.6383681	10.0111887	10.6495568	3
58	9.3509922	9.9887822	9.3622100	10.6377900	10.0112178	10.6490078	2
59	9.3515405	9.9887531	9.3627874	10.6372126	10.0112469	10.6484595	1
60	9.3520880	9 9887239	9.3633641	10.6366359	10.0112761	10.6479120	0
		Sine.		Tang.		Secant	M

77 *Degrees.*

A Table of Artificial Sines,

13 *Degrees.*

M	Sine.		Tang		Secant		
0	9.3520880	9.9887239	9.3633641	10.6366359	10.0112761	10 6479120	60
1	9.3526349	9.9886847	9.3639401	10.6360599	10.0113053	10.6473651	59
2	9.3531810	9.9886655	9.3645155	10.6354845	10.0113345	10.6468190	58
3	9.3537264	9.9886363	9.3650901	10.6349099	10.0113637	10.6462736	57
4	9.3542710	9.9886070	9.3656641	10.6343359	10.0113930	10.6457290	56
5	9.3548150	9 9885776	9.3662374	10.6337626	10.0114224	10.6451850	55
6	9.3553582	9.9885482	9.3668100	10.6331900	10.0114518	10.6446418	54
7	9.3559008	9.9885188	9.3673819	10.6326181	10.0114812	10.6440993	53
8	9 3564426	9.9884894	9.3679532	10.6320468	10.0115106	10.6435574	52
9	9.3569836	9.9884599	9.3685238	10.6314762	10.0115401	10 6430164	51
10	9.3575240	9.9884303	9.3690957	10.6309063	10.0115697	10.6424760	50
11	9.3580637	9.9884008	9.3696629	10.6303371	10.0115992	10.6419363	49
12	9.3586027	9.9883712	9.3702315	10.6297685	10.0116288	10.6413973	48
13	9.3591409	9.9883415	9.3707994	10.6292006	10.0116585	10.6408591	47
14	9.3596785	9.9883118	9.3713667	10.6286333	10.0116882	10.6403215	46
15	9.3602154	9.9882821	9.3719333	10.6280667	10.0117179	10.6397846	45
16	9.3607515	9.9882523	9.3724992	10.6275008	10.0117477	10.6392485	44
17	9.3612870	9.9882225	9.3730645	10.6269355	10.0117775	10.6387130	43
18	9.3618217	9.9881927	9.3736291	10.6263709	10.0118073	10.6381783	42
19	9.3623558	9.9881628	9.3741930	10.6258070	10.0118372	10.6376442	41
20	9.3628892	9.9881329	9.3747563	10.6252437	10.0118671	10.6371108	40
21	9.3634219	9.9881029	9.3753190	10 6246810	10.0118971	10.6365781	39
22	9.3639539	9.9880729	9.3758810	10.6241190	10.0119271	10.6360461	38
23	9.3644852	9.9880429	9.3764423	10.6235577	10.0119571	10.6355148	37
24	9.3650158	9.9880128	9.3770030	10.6229970	10.0119872	10.6349842	36
25	9.3655458	9.9879827	9.3775631	10.6224369	10.0120173	10.6344542	35
26	9.3660750	9.9879525	9.3781225	10.6218775	10.0120475	10.6339250	34
27	9.3666036	9.9879223	9.3786813	10.6213187	10.0120777	10.6333964	33
28	9.3671315	9.9878921	9.3792394	10.6207606	10.0121079	10.6328685	32
29	9.3676587	9.9878618	9.3797969	10.6202031	10.0121382	10.6323413	31
30	9.3681853	9.9878315	9.3803537	10.6196463	10.0121685	10.6318147	30
		Sine.		Tang		Secant	M

76 *Degrees.*

13 *Degrees.*

M	Sine.		Tang		Secant		
30	9.3681853	9.9878315	9.3803537	10.6196463	10.0121685	10.6318147	30
31	9.3687111	9.9878012	9.3809100	10.6190900	10.0121988	10.6312809	29
32	9.3692363	9.9877708	9.3814655	10.6185345	10.0122292	10.6307637	28
33	9.3697608	9.9877404	9.3820205	10.6179795	10.0122596	10.6302392	27
34	9.3702847	9.9877099	9.3825748	10.6174252	10.0122901	10.6297153	26
35	9.3708079	9.9876794	9.3831285	10.6168715	10.0123206	10.6291921	25
36	9.3713304	9.9876488	9.3836816	10.6163184	10.0123512	10.6286696	24
37	9.3718523	9.9876183	9.3842340	10.6157660	10.0123817	10.6281477	23
38	9.3723735	9.9875876	9.3847858	10.6152142	10.0124124	10.6276265	22
39	9.3728940	9.9875570	9.3853370	10.6146630	10.0124430	10.6271060	21
40	9.3734139	9.9875263	9.3858876	10.6141124	10.0124737	10.6265861	20
41	9.3739331	9.9874955	9.3864376	10.6135624	10.0125045	10.6260669	19
42	9.3744517	9.9874648	9.3869869	10.6130131	10.0125352	10.6255483	18
43	9.3749696	9.9874339	9.3875356	10.6124644	10.0125661	10.6250304	17
44	9.3754868	9.9874031	9.3880837	10.6119163	10.0125969	10.6245132	16
45	9.3760034	9.9873722	9.3886312	10.6113688	10.0126278	10.6239966	15
46	9.3765194	9.9873413	9.3891781	10.6108219	10.0126587	10.6234806	14
47	9.3770347	9.9873103	9.3897244	10.6102756	10.0126897	10.6229653	13
48	9.3775493	9.9872793	9.3902700	10.6097300	10.0127207	10.6224507	12
49	9.3780633	9.9872482	9.3908155	10.6091849	10.0127518	10.6219367	11
50	9.3785767	9.9872171	9.3913595	10.6086405	10.0127829	10.6214233	10
51	9.3790894	9.9871860	9.3919034	10.6080966	10.0128140	10.6209106	9
52	9.3796015	9.9871549	9.3924466	10.6075534	10.0128451	10.6203985	8
53	9.3801129	9.9871236	9.3929893	10.6070107	10.0128764	10.6198871	7
54	9.3806237	9.9870924	9.3935313	10.6064487	10.0129076	10.6193763	6
55	9.3811339	9.9870611	9.3940727	10.6059272	10.0129389	10.6188661	5
56	9.3816434	9.9870298	9.3946136	10.6053864	10.0129702	10.6183566	4
57	9.3821523	9.9869984	9.3951538	10.6048462	10.0130016	10.6178477	3
58	9.3826605	9.9869670	9.3956935	10.6043065	10.0130330	10.6173395	2
59	9.3831682	9.9869356	9.3962326	10.6037674	10.0130644	10.6168318	1
60	9.3836752	9.9869041	9.3967711	10.6032289	10.0130959	10.6163248	0
		Sine.		Tang		Secant	M

76 *Degrees.*

A Table of Artificial Sines,

14 *Degrees.*

M	Sine.		Tang		Secant		
0	9.3836752	9.9869041	9.3967711	10.6032289	10.0130959	10.6163248	60
1	9.3841815	9.9868726	9.3973089	10.6026911	10.0131274	10.6158185	59
2	9.3846873	9.9868410	9.3978463	10.6021537	10.0131590	10.6153127	58
3	9.3851924	9.9868094	9.3983830	10.6016170	10.0131906	10.6148070	57
4	9.3856969	9.9867778	9.3989191	10.6010809	10.0132222	10.6143031	56
5	9.3862008	9.9867461	9.3994547	10.6005453	10.0132539	10.6137992	55
6	9.3867040	9.9867144	9.3999896	10.6000104	10.0132856	10.6132960	54
7	9.3872067	9.9866827	9.4005240	10.5994760	10.0133173	10.6127953	53
8	9.3877087	9.9866509	9.4010578	10.5989422	10.0133491	10.6122913	52
9	9.3882101	9.9866191	9.4015910	10.5984090	10.0133809	10.6117899	51
10	9.3887109	9.9865872	9.4021237	10.5978763	10.0134128	10.6112891	50
11	9.3892111	9.9865553	9.4026558	10.5973442	10.0134447	10.6107889	49
12	9.3897106	9.9865233	9.4031873	10.5968127	10.0134767	10.6102894	48
13	9.3902096	9.9864913	9.4037182	10.5962818	10.0135087	10.6097904	47
14	9.3907079	9.9864593	9.4042486	10.5957514	10.0135407	10.6092921	46
15	9.3912057	9.9864273	9.4047784	10.5952216	10.0135727	10.6087943	45
16	9.3917028	9.9863952	9.4053076	10.5946924	10.0136048	10.6082972	44
17	9.3921993	9.9863630	9.4058363	10.5941637	10.0136370	10.6078007	43
18	9.3926952	9.9863308	9.4063644	10.5936356	10.0136692	10 6073048	42
19	9.3931905	9.9862986	9.4068919	10.5931081	10.0137014	10.6068005	41
20	9.3936852	9.9862663	9.4074189	10.5925811	10.0137337	10.6063148	40
21	9.3941794	9.9862340	9.4079453	10.5920547	10.0137660	10.6058206	39
22	9.3946729	9.9862017	9.4084712	10.5915288	10.0137983	10.6053271	38
23	9.3951658	9.9861693	9.4089965	10.5910035	10.0138307	10.6048342	37
24	9.3956581	9.9861369	9.4095212	10.5904788	10.0138631	10.6043419	36
25	9.3961499	9.9861045	9.4100454	10.5899546	10.0138955	10.6038501	35
26	9.3966410	9.9860720	9.4105690	10.5894310	10.0139280	10.6033590	34
27	9.3971315	9.9860394	9.4110921	10.5889079	10.0139606	10.6028685	33
28	9.3976215	9.9860069	9.4116146	10.5883854	10.0139931	10.6023785	32
29	9.3980	9.9859742	9.4121366	10.5878634	10.0140258	10.6018891	31
30	9.3985996	9.9859416	9.4126581	10.5873419	10.0140584	10.6014004	30
		Sine.		Tang		Secant	M

75 *Degrees.*

14 *Degrees.*

M	Sine.		Tang		Secant		
30	9.3985996	9.9859416	9.4126581	10.5873419	10.0140584	10.6014004	30
31	9.3990878	9.9859089	9.4131789	10.5868211	10.0140911	10.6009122	29
32	9.3995754	9.9858762	9.4136993	10.5863007	10.0141238	10.6004246	28
33	9.4000625	9.9858434	9.4142191	10.5857809	10.0141566	10.5999375	27
34	9.4005486	9.9858106	9.4147383	10.5852617	10.0141894	10.5994511	26
35	9.4010343	9.9857777	9.4152570	10.5847430	10.0142223	10.5989652	25
36	9.4015201	9.9857449	9.4157752	10.5842248	10.0142551	10.5984799	24
37	9.4020048	9.9857119	9.4162928	10.5837072	10.0142881	10.5979952	23
38	9.4024889	9.9856790	9.4168099	10.5831901	10.0143210	10.5975111	22
39	9.4029734	9.9856460	9.4173265	10.5826735	10.0143540	10.5970276	21
40	9.4034554	9.9856129	9.4178425	10.5821575	10.0143871	10.5965446	20
41	9.4039378	9.9855798	9.4183580	10.5816420	10.0144202	10.5960622	19
42	9.4044196	9.9855467	9.4188729	10.5811271	10.0144533	10.5955804	18
43	9.4049009	9.9855135	9.4193874	10.5806126	10.0144865	10.5950991	17
44	9.4053816	9.9854803	9.4199013	10.5800987	10.0145197	10.5946184	16
45	9.4058617	9.9854471	9.4204146	10.5795854	10.0145529	10.5941383	15
46	9.4063413	9.9854138	9.4209275	10.5790725	10.0145862	10.5936587	14
47	9.4068203	9.9853805	9.4214398	10.5785602	10.0146195	10.5931797	13
48	9.4072987	9.9853471	9.4219515	10.5780485	10.0146529	10.5927013	12
49	9.4077766	9.9853138	9.4224628	10.5775372	10.0146862	10.5922234	11
50	9.4082539	9.9852803	9.4229735	10.5770265	10.0147197	10.5917461	10
51	9.4087306	9.9852468	9.4234838	10.5765162	10.0147532	10.5912694	9
52	9.4092068	9.9852133	9.4239935	10.5760065	10.0147867	10.5907932	8
53	9.4096824	9.9851798	9.4245026	10.5754974	10.0148202	10.5903176	7
54	9.4101575	9.9851462	9.4250113	10.5749887	10.0148538	10.5898425	6
55	9.4106320	9.9851125	9.4255194	10.5744806	10.0148875	10.5893680	5
56	9.4111059	9.9850789	9.4260271	10.5739729	10.0149211	10.5888941	4
57	9.4115793	9.9850452	9.4265342	10.5734658	10.0149548	10.5884207	3
58	9.4120522	9.9850114	9.4270408	10.5729592	10.0149886	10.5879478	2
59	9.4125245	9.9849776	9.4275469	10.5724531	10.0150224	10.5874755	1
60	9.4129962	9.9849438	9.4280525	10.5719475	10.0150562	10.5870038	0
		Sine.		Tang		Secant	M

75 *Degrees.*

A Table of Artificial Sines,

15 *Degrees.*

M	Sine.		Tang		Secant		
0	9.4129962	9.9849438	9.4280525	10.5719475	10.0150562	10.5870038	60
1	9.4134674	9.9849099	9.4285575	10.5714425	10.0150901	10.5865326	59
2	9.4139381	9.9848760	9.4290621	10.5709379	10.0151240	10.5860619	58
3	9.4144082	9.9848420	9.4295661	10.5704339	10.0151580	10.5855918	57
4	9.4148778	9.9848081	9.4300697	10.5699303	10.0151919	10.5851222	56
5	9.4153408	9.9847740	9.4305727	10.5694273	10.0152260	10.5846532	55
6	9.4158152	9.9847400	9.4310753	10.5689247	10.0152600	10.5841848	54
7	9.4162832	9.9847059	9.4315773	10.5684227	10.0152941	10.5837168	53
8	9.4167506	9.9846717	9.4320789	10.5679211	10.0153283	10.5832494	52
9	9.4172174	9.9846375	9.4325799	10.5674201	10.0153625	10.5827826	51
10	9.4176837	9.9846033	9.4330804	10.5669196	10.0153967	10.5823163	50
11	9.4181495	9.9845690	9.4335805	10.5664195	10.0154310	10.5818505	49
12	9.4186148	9.9845347	9.4340800	10.5659200	10.0154653	10.5813852	48
13	9.4190795	9.9845004	9.4345791	10.5654209	10.0154996	10.5809205	47
14	9.4195436	9.9844660	9.4350776	10.5649224	10.0155340	10.5804564	46
15	9.4200073	9.9844316	9.4355757	10.5644243	10.0155684	10.5799927	45
16	9.4204704	9.9843971	9.4360733	10.5639267	10.0156029	10.5795296	44
17	9.4209330	9.9843626	9.4365704	10.5634296	10.0156374	10.5790670	43
18	9.4213950	9.9843281	9.4370670	10.5629330	10.0156719	10.5786050	42
19	9.4218566	9.9842935	9.4375631	10.5624369	10.0157065	10.5781434	41
20	9.4223176	9.9842589	9.4380587	10.5619413	10.0157411	10.5776824	40
21	9.4227780	9.9842242	9.4385538	10.5614462	10.0157758	10.5772220	39
22	9.4232380	9.9841895	9.4390485	10.5609515	10.0158105	10.5767620	38
23	9.4236974	9.9841548	9.4395426	10.5604574	10.0158452	10.5763026	37
24	9.4241563	9.9841200	9.4400363	10.5599637	10.0158800	10.5758437	36
25	9.4246147	9.9840852	9.4405295	10.5594705	10.0159148	10.5753853	35
26	9.4250726	9.9840503	9.4410222	10.5589778	10.0159497	10.5749274	34
27	9.4255299	9.9840154	9.4415145	10.5584855	10.0159846	10.5744701	33
28	9.4259867	9.9839805	9.4420062	10.5579938	10.0160195	10.5740133	32
29	9.4264430	9.9839455	9.4424975	10.5575025	10.0160545	10.5735570	31
30	9.4268988	9.9839105	9.4429883	10.5570117	10.0160895	10.5731012	30
		Sine.		Tang		Secant	M

74 *Degrees.*

15 *Degrees.*

M	Sine.		Tang		Secant		
30	9.4268988	9.9839105	9.4429883	10.5570117	10.0160895	10.5731012	30
31	9.4273541	9.9838755	9.4434786	10.5565214	10.0161245	10.5726459	29
32	9.4278089	9.9838404	9.4439685	10.5560315	10.0161596	10.5721911	28
33	9.4282631	9.9838052	9.4444579	10.5555421	10.0161948	10.5717369	27
34	9.4287169	9.9837701	9.4449468	10.5550532	10.0162299	10.5712831	26
35	9.4291701	9.9837348	9.4454352	10.5545648	10.0162652	10.5708299	25
36	9.4296228	9.9836996	9.4459232	10.5540768	10.0163004	10.5703772	24
37	9.4300750	9.9836643	9.4464107	10.5535893	10.0163357	10.5699250	23
38	9.4305267	9.9836290	9.4468978	10.5531022	10.0163710	10.5694733	22
39	9.4309779	9.9835936	9.4473843	10.5526157	10.0164064	10.5690221	21
40	9.4314286	9.9835582	9.4478704	10.5521296	10.0164418	10.5685714	20
41	9.4318788	9.9835227	9.4483561	10.5516439	10.0164773	10.5681212	19
42	9.4323285	9.9834872	9.4488413	10.5511587	10.0165128	10.5676715	18
43	9.4327777	9.9834517	9.4493260	10.5506740	10.0165483	10.5672223	17
44	9.4332264	9.9834161	9.4498102	10.5501898	10.0165839	10.5667736	16
45	9.4336746	9.9833805	9.4502940	10.5497060	10.0166195	10.5663254	15
46	9.4341223	9.9833449	9.4507774	10.5492226	10.0166551	10.5658777	14
47	9.4345694	9.9833092	9.4512602	10.5487398	10.0166908	10.5654306	13
48	9.4350161	9.9832735	9.4517427	10.5482573	10.0167265	10.5649839	12
49	9.4354623	9.9832377	9.4522246	10.5477754	10.0167623	10.5645377	11
50	9.4359080	9.9832019	9.4527061	10.5472939	10.0167981	10.5640920	10
51	9.4363532	9.9831661	9.4531872	10.5468128	10.0168339	10.5636468	9
52	9.4367980	9.9831302	9.4536678	10.5463322	10.0168698	10.5632020	8
53	9.4372422	9.9830942	9.4541479	10.5458521	10.0169058	10.5627578	7
54	9.4376859	9.9830583	9.4546276	10.5453724	10.0169417	10.5623141	6
55	9.4381292	9.9830223	9.4551069	10.5448931	10.0169777	10.5618708	5
56	9.4385719	9.9829862	9.4555857	10.5444143	10.0170138	10.5614281	4
57	9.4390142	9.9829501	9.4560641	10.5439359	10.0170499	10.5609858	3
58	9.4394560	9.9829140	9.4565420	10.5434580	10.0170860	10.5605440	2
59	9.4398973	9.9828778	9.4570194	10.5429806	10.0171222	10.5601027	1
60	9.4403381	9.9828416	9.4574964	10.5425036	10.0171586	10.5596619	0
		Sine.		Tang.		Secant	M

74 *Degrees.*

A Table of Artificial Sines,

16 *Degrees.*

M	Sine.		Tang		Secant		
0	9.4403381	9.9828416	9.4574964	10.5425036	10.017[illegible]584	10.5596619	60
1	9.4407784	9.9828054	9.4579730	10.5420270	10.0171946	10.5592216	59
2	9.4412182	9.9827691	9.4584491	10.5415509	10.0172309	10.5587818	58
3	9.4416576	9.9827328	9.4589248	10.5410752	10.0172672	10.5583424	57
4	9.4420965	9.9826964	9.4594001	10.5405999	10.0173036	10.5579035	56
5	9.4425349	9.9826600	9.4598749	10.5401251	10.0173400	10.5574651	55
6	9.4429728	9.9826236	9.4603492	10.5396508	10.0173764	10.5570272	54
7	9.4434103	9.9825871	9.4608232	10.5391768	10.0174129	10.5565897	53
8	9.4438472	9.9825506	9.4612967	10.5387033	10.0174494	10.5561528	52
9	9.4442837	9.9825140	9.4617697	10.5382303	10.0174860	10.5557163	51
10	9.4447197	9.9824774	9.4622423	10.5377577	10.0175226	10.5552803	50
11	9.4451553	9.9824408	9.4627145	10.5372855	10.0175592	10.5548447	49
12	9.4455904	9.9824041	9.4631863	10.5368137	10.0175959	10.5544096	48
13	9.4460250	9.9823674	9.4636576	10.5363424	10.0176326	10.5539750	47
14	9.4446591	9.9823306	9.4641285	10.5358715	10.0176694	10.5535409	46
15	9.4468927	9.9822938	9.4645990	10.5354010	10.0177062	10.5531073	45
16	9.4473259	9.9822569	9.4650690	10.5349310	10.0177431	10.5526741	44
17	9.4477586	9.9822201	9.4655386	10.5344614	10.0177799	10.5522414	43
18	9.4481909	9.9821831	9.4660078	10.5339922	10.0178169	10.5518091	42
19	9.4486227	9.9821462	9.4664765	10.5335235	10.0178538	10.5513773	41
20	9.4490540	9.9821092	9.4669448	10.5330552	10.0178908	10.5509460	40
21	9.4494849	9.9820721	9.4674127	10.5325873	10.0179279	10.5505151	39
22	9.4499153	9.9820351	9.4678802	10.5321198	10.0179649	10.5500847	38
23	9.4503452	9.9819970	9.4683473	10.5316527	10.0180021	10.5496548	37
24	9.4507747	9.9819608	9.4688139	10.5311861	10.0180392	10.5492253	36
25	9.4512037	9.9819236	9.4692801	10.5307199	10.0180764	10.5487963	35
26	9.4516322	9.9818863	9.4697459	10.5302541	10.0181137	10.5483678	34
27	9.4520603	9.9818490	9.4702112	10.5297888	10.0181510	10.5479397	33
28	9.4524879	9.9818117	9.4706762	10.5293238	10.0181883	10.5475121	32
29	9.4529151	9.9817744	9.4711407	10.5288593	10.0182256	10.5470849	31
30	9.4533418	9.9817370	9.4716048	10.5283952	10.0182630	10.5466582	30
		Sine.		Tang		Secant	M

73 *Degrees.*

16 *Degrees.*

M	Sine.		Tang		Secant		
30	9.4533418	9.9817370	9.4716048	10.5283952	10.0182630	10.5466582	30
31	9.4537681	9.9816995	9.4720685	10.5279315	10.0183005	10.5462319	29
32	9.4541939	9.9816620	9.4725318	10.5274682	10.0183380	10.5458061	28
33	9.4546192	9.9816245	9.4729947	10.5270053	10.0183755	10.5453808	27
34	9.4550441	9.9815870	9.4734571	10.5265428	10.0184130	10.5449559	26
35	9.4554686	9.9815494	9.4739192	10.5260808	10.0184506	10.5445314	25
36	9.4558926	9.9815117	9.4743808	10.5256192	10.0184883	10.5441074	24
37	9.4563161	9.9814740	9.4748421	10.5251579	10.0185260	10.5436839	23
38	9.4567392	9.9814363	9.4753029	10.5246971	10.0185637	10.5432608	22
39	9.4571618	9.9813986	9.4757633	10.5242367	10.0186014	10.5428382	21
40	9.4575840	9.9813608	9.4762233	10.5237767	10.0186392	10.5424160	20
41	9.4580058	9.9813229	9.4766829	10.5233171	10 0186771	10 5419942	19
42	9.4584271	9.9812850	9.4771421	10.5228579	10.0187150	10.5415729	18
43	9.4588480	9.9812471	9.4776009	10.5223991	10.0187529	10 5411520	17
44	9.4592684	9.9812091	9.4780592	10.5219408	10 0187909	10 5407316	16
45	9.4596884	9.9811711	9.4785172	10.5214828	10.0188289	10.5403116	15
46	9.4601079	9.9811331	9.4789748	10.5210252	10.0188669	10.5398921	14
47	9.4605270	9.9810950	9.4794319	10.5205681	10.0189050	10.5394730	13
48	9.4609456	9.9810569	9.4798887	10.5201113	10.0189431	10.5390544	12
49	9.4613638	9.9810187	9.4803451	10.5196549	10.0189813	10.5386362	11
50	9.4617816	9.9809805	9.4808011	10.5191989	10.0190195	10.5382184	10
51	9.4621989	9.9809423	9.4812566	10.5187434	10.0190577	10.5378011	9
52	9.4626158	9.9809040	9.4817118	10.5182882	10.0190960	10.5373842	8
53	9.4630323	9.9808657	9.4821666	10.5178334	10.0191343	10.5369677	7
54	9.4634483	9.9808273	9.4826210	10.5173790	10.0191727	10.5365517	6
55	9.4638639	9.9807889	9.4830750	10.5169250	10.0192111	10.5361361	5
56	9.4642790	9.9807505	9.4835286	10.5164714	10.0192495	10.5357210	4
57	9.4646938	9.9807120	9.4839818	10.5160182	10.0192880	10.5353062	3
58	9.4651081	9.9806735	9.4844346	10.5155654	10.0193265	10.5348919	2
59	9.4655219	9.9806349	9.4848870	10.5151130	10.0193651	10.5344781	1
60	9.4659353	9.9805963	9.4853390	10.5146610	10.0194037	10.5340647	0
		Sine.		Tang.		Secant	M

73 *Degrees.*

17 Degrees.

M	Sine		Tang		Secant		
0	9.4659353	9.9805963	9.4853390	10.5146610	10.0194037	10.5340647	60
1	9.4663483	9.9805577	9.4857907	10.5142093	10.0194423	10.5336517	59
2	9.4667609	9.9805190	9.4862419	10.5137581	10.0194810	10.5332391	58
3	9.4671730	9.9804803	9.4866928	10.5133072	10.0195197	10.5328270	57
4	9.4675848	9.9804415	9.4871433	10.5128567	10.0195585	10.5324152	56
5	9.4679960	9.9804027	9.4875933	10.5124067	10.0195973	10.5320040	55
6	9.4684069	9.9803639	9.4880430	10.5119570	10.0196361	10.5315931	54
7	9.4688173	9.9803250	9.4884924	10.5115076	10.0196750	10.5311827	53
8	9.4692273	9.9802860	9.4889413	10.5110587	10.0197140	10.5307727	52
9	9.4696369	9.9802471	9.4893898	10.5106102	10.0197529	10.5303631	51
10	9.4700461	9.9802081	9.4898380	10.5101620	10.0197919	10.5299539	50
11	9.4704548	9.9801690	9.4902858	10.5097142	10.0198310	10.5295452	49
12	9.4708631	9.9801299	9.4907332	10.5092668	10.0198701	10.5291369	48
13	9.4712710	9.9800908	9.4911802	10.5088198	10.0199092	10.5287290	47
14	9.4716785	9.9800516	9.4916269	10.5083731	10.0199484	10.5283215	46
15	9.4720856	9.9800124	9.4920731	10.5079269	10.0199876	10.5279144	45
16	9.4724922	9.9799732	9.4925190	10.5074810	10.0200268	10.5275078	44
17	9.4728985	9.9799339	9.4929646	10.5070354	10.0200661	10.5271015	43
18	9.4733043	9.9798946	9.4934097	10.5065903	10.0201054	10.5266957	42
19	9.4737097	9.9798552	9.4938545	10.5061455	10.0201448	10.5262903	41
20	9.4741146	9.9798158	9.4942988	10.5057012	10.0201842	10.5258854	40
21	9.4745192	9.9797764	9.4947429	10.5052571	10.0202236	10.5254808	39
22	9.4749234	9.9797369	9.4951865	10.5048135	10.0202631	10.5250766	38
23	9.4753271	9.9796973	9.4956298	10.5043702	10.0203027	10.5246729	37
24	9.4757304	9.9796578	9.4960727	10.5039273	10.0203422	10.5242696	36
25	9.4761334	9.9796182	9.4965152	10.5034848	10.0203818	10.5238666	35
26	9.4765359	9.9795785	9.4969574	10.5030426	10.0204215	10.5234641	34
27	9.4769380	9.9795388	9.4973991	10.5026009	10.0204612	10.5230620	33
28	9.4773396	9.9794991	9.4978406	10.5021594	10.0205009	10.5226604	32
29	9.4777409	9.9794593	9.4982816	10.5017184	10.0205407	10.5222591	31
30	9.4781418	9.9794195	9.4987223	10.5012777	10.0205805	10.5218582	30
		Sine.		Tang		Secant	M

72 Degrees.

17 *Degrees.*

M	Sine.		Tang		Secant		
30	9.4781418	9.9794195	9.4987223	10.5012777	10.0205805	10.5218582	30
31	9.4785423	9.9793796	9.4991626	10.5008374	10.0206204	10.5214577	29
32	9.4789423	9.9793398	9.4996026	10.5003974	10.0206602	10.5210577	28
33	9.4793420	9.9792998	9.5000422	10.4999578	10.0207002	10.5206580	27
34	9.4797412	9.9792599	9.5004814	10.4995186	10.0207402	10.5202588	26
35	9.4801401	9.9792198	9.5009203	10.4990797	10.0207802	10.5198599	25
36	9.4805385	9.9791798	9.5013588	10.4986412	10.0208202	10.5194615	24
37	9.4809366	9.9791397	9.5017969	10.4982031	10.0208603	10.5190634	23
38	9.4813342	9.9790996	9.5022347	10.4977653	10.0209004	10.5186658	22
39	9.4817315	9.9790594	9.5026721	10.4973279	10.0209406	10.5182685	21
40	9.4821283	9.9790192	9.5031092	10.4968908	10.0209808	10.5178717	20
41	9.4825248	9.9789789	9.5035459	10.4964541	10.0210211	10.5174752	19
42	9.4829208	9.9789386	9.5039822	10.4960178	10.0210614	10.5170792	18
43	9.4833165	9.9788983	9.5044182	10.4955818	10.0211017	10.5166835	17
44	9.4837117	9.9788579	9.5048538	10.4951462	10.0211421	10.5162883	16
45	9.4841066	9.9788175	9.5052891	10.4947109	10.0211825	10.5158934	15
46	9.4845010	9.9787770	9.5057240	10.4942760	10.0212230	10.5154990	14
47	9.4848951	9.9787365	9.5061586	10.4938414	10.0212635	10.5151049	13
48	9.4852888	9.9786960	9.5065928	10.4934072	10.0213040	10.5147112	12
49	9.4856820	9.9786554	9.5070267	10.4929733	10.0213446	10.5143180	11
50	9.4860749	9.9786148	9.5074602	10.4925398	10.0213852	10.5139251	10
51	9.4864674	9.9785741	9.5078933	10.4921067	10.0214259	10.5135326	9
52	9.4868595	9.9785334	9.5083261	10.4916739	10.0214666	10.5131405	8
53	9.4872512	9.9784927	9.5087586	10.4912414	10.0215073	10.5127488	7
54	9.4876426	9.9784519	9.5091907	10.4908093	10.0215481	10.5123574	6
55	9.4880335	9.9784111	9.5096224	10.4903776	10.0215889	10.5119665	5
56	9.4884240	9.9783702	9.5100539	10.4899461	10.0216298	10.5115760	4
57	9.4888142	9.9783293	9.5104849	10.4895151	10.0216707	10.5111858	3
58	9.4892040	9.9782883	9.5109156	10.4890844	10.0217117	10.5107960	2
59	9.4895934	9.9782474	9.5113460	10.4886540	10.0217526	10.5104066	1
60	9.4899824	9.9782063	9.5117760	10.4882240	10.0217937	10.5100176	0
		Sine.		Tang		Secant	M

72 *Degrees.*

A Table of Artificial Sines,

18 *Degrees.*

M	Sine.		Tang		Secant		
0	9.4899824	9.9782062	9.5117760	10.4882240	10.0217937	10.5100176	60
1	9.4903710	9.9781653	9.5126057	10.4877943	10.0218347	10.5096290	59
2	9.4907592	9.9781241	9.5126351	10.4873649	10.0218759	10.5092408	58
3	9.4911471	9.9780830	9.5130641	10.4869359	10.0219170	10.5088529	57
4	9.4915345	9.9780418	9.5134927	10.4865073	10.0219582	10.5084655	56
5	9.4919216	9.9780006	9.5139210	10.4860790	10.0219994	10.5080784	55
6	9.4923083	9.9779593	9.5143490	10.4856510	10 0220407	10.5076917	54
7	9.4926946	9 9779180	9.5147766	10.4852234	10.0220820	10.5073054	53
8	9.4930806	9.9778766	9.5152039	10.4847961	10.0221233	10.5069194	52
9	9.4934661	9.9778353	9.5156309	10.4843691	10.0221647	10.5065339	51
10	9.4938513	9.9777938	9.5160575	10.4839425	10.0222062	10.5061487	50
11	9.4942361	9.9777523	9.5164838	10.4835162	10.0222477	10.5057639	49
12	9.4946205	9.9777108	9.5169097	10.4830903	10.0222892	10.5053795	48
13	9.4950046	9.9776693	9.5173353	10.4826647	10.0223307	10.5049954	47
14	9.4953883	9.9776277	9.5177606	10.4822394	10.0223723	10.5046117	46
15	9.4957716	9.9775860	9.5181855	10.4818145	10.0224140	10.5042284	45
16	9.4961545	9.9775444	9.5186101	10.4813899	10.0224556	10.5038455	44
17	9.4965370	9.9775026	9.5190344	10.4809656	10.0224974	10.5034630	43
18	9.4969192	9.9774609	9.5194583	10.4805417	10.0225391	10.5030808	42
19	9.4973010	9.9774191	9.5198819	10.4801181	10.0225809	10.5026990	41
20	9.4976824	9.9773772	9.5203052	10.4796948	10.0226228	10.5023176	40
21	9.4980635	9.9773354	9.5207282	10.4792718	10.0226646	10.5019365	39
22	9.4984442	9.9772934	9.5211508	10.4788492	10.0227066	10.5015558	38
23	9.4988245	9.9772515	9.5215730	10.4784270	10.0227485	10.5011755	37
24	9.4992045	9.9772095	9.5219950	10.4780050	10.0227905	10.5007955	36
25	9.4995840	9.9771674	9.5224166	10.4775834	10.0228326	10.5004160	35
26	9.4999633	9.9771253	9.5228379	10.477162	10.0228747	10.5000367	34
27	9.5003421	9.9770832	9.5232589	10.4767411	10.0229168	10.4996579	33
28	9.5007206	9.9770410	9.5236795	10.4763205	10.0229590	10.4992794	32
29	9.5010987	9.9769988	9.5240999	10.4759001	10.0230012	10.4989013	31
30	9.5014764	9.9769566	9.5245199	10.4754801	10.0230434	10.4985236	30
		Sine.		Tang		Secant	M

71 *Degrees.*

18 *Degrees.*

M	Sine		Tang		Secant		
30	9.5014764	9.9769566	9.5245199	10.4754801	10.0230434	10.4985236	30
31	9.5018538	9.9769143	9.5249395	10.4750605	10.0230857	10.4981462	29
32	9.5022308	9.9768720	9.5253589	10.4746411	10.0231280	10.4977692	28
33	9.5026075	9.9768296	9.5257779	10.4742221	10.0231704	10.4973925	27
34	9.5029838	9.9767872	9.5261966	10.4738034	10.0232128	10.4970162	26
35	9.5033598	9.9767447	9.5266150	10.4733850	10.0232553	10.4966403	25
36	9.5037353	9.9767022	9.5270331	10.4729669	10.0232978	10.4962647	24
37	9.5041105	9.9766597	9.5274508	10.4725492	10.0233403	10.4958895	23
38	9.5044853	9.9766171	9.5278682	10.4721318	10.0233829	10.4955147	22
39	9.5048598	9.9765745	9.5282853	10.4717142	10.0234255	10.4951402	21
40	9.5052339	9.9765318	9.5287021	10.4712979	10.0234682	10.4947661	20
41	9.5056077	9.9764891	9.5291186	10.4708814	10.0235109	10.4943923	19
42	9.5059811	9.9764464	9.5295347	10.4704653	10.0235536	10.4940189	18
43	9.5063542	9.9764036	9.5299505	10.4700495	10.0235964	10.4936458	17
44	9.5067269	9.9763608	9.5303661	10.4696339	10.0236392	10.4932731	16
45	9.5070992	9.9763179	9.5307813	10.4692187	10.0236821	10.4929008	15
46	9.5074712	9.9762750	9.5311961	10.4688039	10.0237250	10.4925288	14
47	9.5078428	9.9762321	9.5316107	10.4683893	10.0237679	10.4921572	13
48	9.5082141	9.9761891	9.5320250	10.4679750	10.0238109	10.4917859	12
49	9.5085850	9.9761461	9.5324389	10.4675611	10.0238539	10.4914150	11
50	9.5089556	9.9761030	9.5328526	10.4671474	10.0238970	10.4910444	10
51	9.5093258	9.9760599	9.5332659	10.4667341	10.0239401	10.4906742	9
52	9.5096956	9.9760167	9.5336789	10.4663211	10.0239833	10.4903044	8
53	9.5100651	9.9759736	9.5340916	10.4659084	10.0240264	10.4899349	7
54	9.5104343	9.9759303	9.5345040	10.4654960	10.0240697	10.4895657	6
55	9.5108031	9.9758870	9.5349161	10.4650839	10.0241130	10.4891969	5
56	9.511 716	9.9758437	9.5353278	10.4646722	10.0241563	10.4888284	4
57	9.5115397	9.9758004	9.5357393	10.4642607	10.0241996	10.4884603	3
58	9.5119074	9.9757570	9.5361505	10.4638495	10.0242430	10.4880026	2
59	9.5122749	9.9757135	9.5365613	10.4634387	10.0242865	10.4877251	1
60	9.5126419	9.9756701	9.5369719	10.4630281	10.0243299	10.4873581	0
		Sine.		Tang		Secant	M

71 *Degrees.*

A Table of Artificial Sines,

19 Degrees.

M	Sine.		Tang		Secant		
0	9.5126419	9.9756701	9.5369719	10.4630281	10.0243299	10.4873581	60
1	9.5130086	9.9756265	9.5373821	10.4626179	10.0243735	10.4869914	59
2	9.5133750	9.9755830	9.5377920	10.4622080	10.0244170	10.4866250	58
3	9.5137410	9.9755394	9.5382017	10.4617983	10.0244606	10.4862590	57
4	9.5141067	9.9754957	9.5386110	10.4613890	10.0245403	10.4858933	56
5	9.5144721	9.9754521	9.5390200	10.4609800	10.0245479	10.4855279	55
6	9.5148371	9.9754083	9.5394287	10.4605713	10.0245917	10.4851629	54
7	9.5152017	9 9753646	9.5398371	10.4601629	10.0246354	10.4847983	53
8	9.5155660	9.9753208	9.5402453	10.4597547	10.0246792	10.4844340	52
9	9.5159300	9.9752769	9.5406531	10.4593469	10.0247231	10.4840700	51
10	9.5162936	9.9752330	9.5410606	10.4589394	10.0247670	10.4837064	50
11	9.5166569	9.9751891	9.5414678	10.4585322	10.0248109	10.4833431	49
12	9.5170198	9.9751451	9.5418747	10.4581253	10.0248549	10.4829802	48
13	9.5173824	9.9751011	9.5422813	10.4577187	10.0248989	10.4826176	47
14	9.5177447	9.9750570	9.5426877	10.4573123	10.0249430	10.4822553	46
15	9.5181066	9.9750129	9.5430937	10.4569063	10.0249871	10.4818934	45
16	9.5184682	9.9749688	9.5434994	10.4565006	10.0250312	10.4815318	44
17	9.5188295	9.9749246	9.5439048	10.4560952	10.0250754	10.4811705	43
18	9.5191904	9.9748804	9.5443100	10.4556900	10.0251196	10.4808096	42
19	9.5195510	9.9748361	9.5447148	10.4552852	10.0251639	10.4804490	41
20	9.5199112	9.9747918	9.5451193	10.4548807	10.0252082	10.4800888	40
21	9.5202711	9.9747475	9.5455236	10.4544764	10.0252525	10.4797289	39
22	9.5206307	9.9747031	9.5459276	10.4540724	10.0252969	10 4793693	38
23	9.5209899	9.9746587	9.5463312	10.4536688	10.0253413	10.4790101	37
24	9.5213488	9.9746142	9.5467346	10.4532654	10.0253858	10.4786512	36
25	9.5217074	9.9745697	9.5471377	10.4528623	10.0254303	10.4782926	35
26	9.5220656	9.9745252	9.5475405	10.4524595	10.0254748	10.4779344	34
27	9.5224235	9.9744806	9.5479430	10.4520570	10.0255194	10.4775765	33
28	9.5227811	9.9744359	9.5483452	10.4516548	10.0255641	10.4772189	32
29	9.5231383	9.9743913	9.5487471	10.4512529	10.0256087	10.4768617	31
30	9.5234953	9.9743466	9.5491487	10.4508513	10.0256534	10.4765047	30
		Sine.		Tang		Secant	M

70 Degrees.

19 *Degrees.*

M	Sine.		Tang		Secant		
30	9.5234953	9.9743466	9.5491487	10.4508513	10.0256534	10.4765047	30
31	9.5238518	9.9743018	9.5495500	10.4504500	10.0256982	10.4761482	29
32	9.5242081	9.9742570	9.5499511	10.4500489	10.0257430	10.4757919	28
33	9.5245640	9.9742122	9.5503519	10.4496481	10.0257878	10.4754360	27
34	9.5249196	9.9741673	9.5507523	10.4492477	10.0258327	10.4750804	26
35	9.5252749	9.9741224	9.5511525	10.4488475	10.0258776	10.4747251	25
36	9.5256298	9.9740774	9.5515524	10.4484476	10.0259226	10.4743702	24
37	9.5259844	9.9740324	9.5519521	10.4480479	10.0259676	10.4740156	23
38	9.5263387	9.9739873	9.5523514	10.4476486	10.0260127	10.4736613	22
39	9.5266927	9.9739422	9.5527504	10.4472496	10.0260578	10.4733073	21
40	9.5270463	9.9738971	9.5531492	10.4468508	10.0261029	10.4729537	20
41	9.5273997	9.9738519	9.5535477	10.4464523	10.0261481	10.4726003	19
42	9.5277526	9.9738067	9.5539459	10.4460541	10.0261933	10.4722474	18
43	9.5281053	9.9737615	9.5543438	10.4456562	10.0262385	10.4718947	17
44	9.5284577	9.9737162	9.5547415	10.4452585	10.0262838	10.4715423	16
45	9.5288097	9.9736709	9.5551388	10.4448612	10.0263291	10.4711903	15
46	9.5291614	9.9736255	9.5555359	10.4444641	10.0263745	10.4708386	14
47	9.5295128	9.9735801	9.5559327	10.4440673	10.0264199	10.4704872	13
48	9.5298638	9.9735346	9.5563292	10.4436708	10.0264654	10.4701362	12
49	9.5302146	9.9734891	9.5567255	10.4432745	10.0265109	10.4697854	11
50	9.5305650	9.9734435	9.5571214	10.4428786	10.0265565	10.4694350	10
51	9.5309151	9.9733980	9.5575171	10.4424829	10.0266020	10.4690849	9
52	9.5312649	9.9733523	9.5579125	10.4420875	10.0266477	10.4687351	8
53	9.5316143	9.9733067	9.5583077	10.4416923	10.0266933	10.4683857	7
54	9.5319635	9.9732610	9.5587025	10.4412975	10.0267390	10.4680365	6
55	9.5323123	9.9732152	9.5590971	10.4409029	10.0267848	10.4676877	5
56	9.5326608	9.9731694	9.5594914	10.4405086	10.0268306	10.4673392	4
57	9.5330090	9.9731236	9.5598854	10.4401146	10.0268764	10.4669910	3
58	9.5333569	9.9730777	9.5602792	10.4397208	10.0269223	10.4666431	2
59	9.5337044	9.9730318	9.5606727	10.4393273	10.0269682	10.4662956	1
60	9.5340517	9.9729858	9.5610659	10.4389341	10.0270142	10.4659483	0
		Sine.		Tang.		Secant	M

70 *Degrees.*

A Table of Artificial Sines,

20 Degrees.

M	Sine.		Tang		Secant		
0	9.5340517	9.9729858	9.5610659	10.4389341	10.0270142	10.4659483	60
1	9.5343986	9.9729398	9.5614588	10.4385412	10.0270602	10.4656014	59
2	9.5347452	9.9728938	9.5618515	10.4381485	10.0271062	10.4652548	58
3	9.5350915	9.9728477	9.5622439	10.4377561	10.0271523	10.4649085	57
4	9.5354375	9.9728016	9.5626360	10.4373640	10.0271984	10.4645625	56
5	9.5357832	9.9727554	9.5630278	10.4369722	10.0272446	10.4642168	55
6	9.5361286	9.9727092	9.5634194	10.4365806	10.0272908	10.4638714	54
7	9.5364737	9.9726629	9.5638107	10.4361893	10.0273371	10.4635263	53
8	9.5368184	9.9726166	9.5642018	10.4357982	10.0273834	10.4631816	52
9	9.5371628	9.9725703	9.5645925	10.4354075	10.0274297	10.4628372	51
10	9.5375070	9.9725239	9.5649831	10.4350169	10.0274761	10.4624930	50
11	9.5378508	9.9724775	9.5653733	10.4346267	10.0275225	10.4621492	49
12	9.5381943	9.9724310	9.5657633	10.4342367	10.0275690	10.4618057	48
13	9.5385375	9.9723845	9.5661530	10.4338470	10.0276155	10.4614625	47
14	9.5388804	9.9723380	9.5665424	10.4334576	10.0276620	10.4611196	46
15	9.5392230	9.9722914	9.5669316	10.4330984	10.0277086	10.4607770	45
16	9.5395653	9.9722448	9.5673205	10.4326795	10.0277552	10.4604347	44
17	9.5399073	9.9721981	9.5677091	10.4322909	10.0278019	10.4600927	43
18	9.5402489	9.9721514	9.5680975	10.4319025	10.0278486	10.4597511	42
19	9.5405903	9.9721047	9.5684856	10.4315144	10.0278953	10.4594097	41
20	9.5409314	9.9720579	9.5688735	10.4311265	10.0279421	10.4590686	40
21	9.5[illegible]2721	9.9720110	9.5692611	10.4307389	10.0279890	10.4587279	39
22	9.5416126	9.9719642	9.5696488	10.4303516	10.0280358	10.4583874	38
23	9.5419527	9.9719172	9.5700355	10.4299645	10.0280828	10.4580473	37
24	9.5422926	9.9718703	9.5704223	10.4295777	10.0281297	10.4577074	36
25	9.5426321	9.9718233	9.5708088	10.4291912	10.0281767	10.4573679	35
26	9.5429713	9.9717762	9.5711951	10.4288049	10.0282238	10.4570287	34
27	9.5433103	9.9717291	9.5715811	10.4284189	10.0282709	10.4566897	33
28	9.5436489	9.9716820	9.5719669	10.4280331	10.0283180	10.4563511	32
29	9.5439873	9.9716348	9.5723524	10.4276476	10.0283652	10.4560127	31
30	9.5443253	9.9715876	9.5727377	10.4272623	10.0284124	10.4556747	30
		Sine.		Tang		Secant	M

69 Degrees.

20 Degrees.

M	Sine.		Tang		Secant		
30	9.5443253	9.9715876	9.5727377	10.4272623	10.0284124	10.4556747	30
31	9.5446630	9.9715404	9.5731227	10.4268773	10.0284596	10.4553370	29
32	9.5450005	9.9714931	9.5735074	10.4264926	10.0285069	10.4549995	28
33	9.5453376	9.9714457	9.5738919	10.4261081	10.0285543	10.4546624	27
34	9.5456745	9.9713984	9.5742761	10.4257239	10.0286016	10.4543255	26
35	9.5460110	9.9713509	9.5746601	10.4253399	10.0286491	10.4539890	25
36	9.5463472	9.9713035	9.5750438	10.4249562	10.0286965	10.4536528	24
37	9.5466832	9.9712560	9.5754292	10.4245728	10.0287440	10.4533168	23
38	9.5470189	9.9712084	9.5758104	10.4241896	10.0287916	10.4529811	22
39	9.5473542	9.9711608	9.5761934	10.4238066	10.0288392	10.4526458	21
40	9.5476893	9.9711132	9.5765761	10.4234239	10.0288868	10.4523107	20
41	9.5480240	9.9710655	9.5769585	10.4230415	10.0289345	10.4519760	19
42	9.5483585	9.9710178	9.5773407	10.4226593	10.0289822	10.4516415	18
43	9.5486927	9.9709701	9.5777226	10.4222774	10.0290299	10.4513073	17
44	9.5490266	9.9709223	9.5781043	10.4218957	10.0290777	10.4509734	16
45	9.5493602	9.9708744	9.5784858	10.4215142	10.0291256	10.4506398	15
46	9.5496935	9.9708265	9.5788669	10.4211331	10.0291735	10.4503065	14
47	9.5500265	9.9707786	9.5792479	10.4207521	10.0292214	10.4499735	13
48	9.5503592	9.9707306	9.5796286	10.4203714	10.0292694	10.4496408	12
49	9.5506916	9.9706826	9.5800090	10.4199910	10.0293174	10.4493084	11
50	9.5510237	9.9706346	9.5803892	10.4196108	10.0293654	[illegible]	10
51	9.5513556	9.9705865	9.5807691	10.4192309	10.0294135	10.4486444	9
52	9.5516871	9.9705383	9.5811488	10.4188512	10.0294617	10.4483129	8
53	9.5520184	9.9704902	9.5815282	10.4184718	10.0295098	10.4479816	7
54	9.5523494	9.9704419	9.5819074	10.4180926	10.0295581	10.4476506	6
55	9.5526801	9.9703937	9.5822864	10.4177136	10.0296063	10.4473199	5
56	9.5530105	9.9703454	9.5826651	10.4173349	10.0296546	10.4469895	4
57	9.5533406	9.9702970	9.5830435	10.4169565	10.0297030	10.4466594	3
58	9.5536704	9.9702486	9.5834217	10.4165783	10.0297514	10.4463296	2
59	9.5539999	9.9702002	9.4837997	10.4162003	10.0297998	10.4460001	1
60	9.5543292	9.9701517	9.4841774	10.4158226	10.0298483	10.4456708	0
		Sine.		Tang.		Secant	M

69 Degrees.

A Table of Artificial Sines,

21 *Degrees.*

M	Sine		Tang		Secant		
0	9.5543292	9.9701517	9.5841774	10.4158226	10.0298483	10.4456708	60
1	9.5546581	9.9701032	9.5845549	10.4154451	10.0298968	10.4453419	59
2	9.5549868	9.9700547	9.5849321	10.4150679	10.0299453	10.4450132	58
3	9.5553152	9.9700061	9.5853091	10.4146909	10.0299939	10.4446848	57
4	9.5556433	9.9699574	9.5856859	10.4143141	10.0300426	10.4443567	56
5	9.5559711	9.9699087	9.5860624	10.4139376	10.0300913	10.4440289	55
6	9.5562987	9.9698600	9.5864386	10.4135614	10.0301400	10.4437013	54
7	9.5566259	9.9698112	9.5868147	10.4131853	10.0301888	10.4433741	53
8	9.5569529	9.9697624	9.5871904	10.4128096	10.0302376	10.4430471	52
9	9.5572796	9.9697136	9.5875660	10.4124340	10.0302864	10 4427204	51
10	9.5576060	9.9696647	9.5879413	10.4120587	10.0303353	10.4423940	50
11	9.5579321	9.9696158	9.5883163	10.4116837	10.0303842	10.4420679	49
12	9.5582579	9.9695668	9.5886912	10.4113088	10.0304332	10.4417421	48
13	9.5585835	9.9695177	9.5890657	10.4109343	10.0304823	10.4414165	47
14	9.5589088	9.9694687	9.5894401	10.4105599	10.0305313	10.4410912	46
15	9.5592338	9.9694196	9.5898142	10.4101858	10.0305804	10.4407662	45
16	9.5595585	9.9693704	9.5901881	10.4098119	10.0306296	10.4404415	44
17	9.5598829	9.9693212	9.5905617	10.4094383	10.0306788	10.4401171	43
18	9.5602071	9.9692720	9.5909351	10.4090649	10.0307280	10.4397929	42
19	9.5605310	9.9692227	9.5913082	10.4086918	10.0307773	10.4394690	41
20	9.5608546	9.9691734	9.5916812	10.4083188	10.0308266	10.4391454	40
21	9.5611779	9.9691240	9.5920539	10 4079461	10.0308759	10.4388221	39
22	9.5615010	9.9690746	9.5924263	10.4075737	10.0309254	10.4384990	38
23	9.5618237	9.9690252	9.5927985	10.4072015	10.0309748	10.4381763	37
24	9.5621462	9.9689757	9.5931705	10.4068295	10.0310243	10.4378538	36
25	9.5624685	9.9689262	9.5935423	10.4064577	10.0310738	10.4375315	35
26	9.5627904	9.9688766	9.5939138	10.4060862	10.0311234	10.4372096	34
27	9.5631121	9.9688270	9.5942851	10.4057149	10.0311730	10.4368879	33
28	9.5634335	9.9687773	9.5946561	10.4053439	10.0312227	10.4365665	32
29	9.5637546	9.9687276	9.5950269	10.4049731	10.0312724	10.4362454	31
30	9.5640754	9.9686779	9.5953975	10.4046025	10.0313221	10.4359246	30
		Sine.		Tang		Secant	M

68 *Degrees.*

21 *Degrees.*

M	Sine		Tang		Secant		
30	9.5640754	9.9686779	9.5953975	10.4046025	10.0313221	10.4359246	30
31	9.5643960	9.9686281	9.5957679	10.4042321	10.0313719	10.4356040	29
32	9.5647163	9.9685783	9.5961380	10.4038620	10.0314217	10.4352837	28
33	9.5650363	9.9685284	9.5965079	10.4034921	10.0314716	10.4349637	27
34	9.5653561	9.9684785	9.5968776	10.4031224	10.0315215	10.4346439	26
35	9.5656756	9.9684286	9.5972470	10.4027530	10.0315714	10.4343244	25
36	9.5659948	9.9683786	9.5976162	10.4023838	10.0316214	10.4340052	24
37	9.5663137	9.9683285	9.5979852	10.4020148	10.0316715	10.4336863	23
38	9.5666324	9.9682784	9.5983540	10.4016460	10.0317216	10.4333676	22
39	9.5669508	9.9682283	9.5987225	10.4012775	10.0317717	10.4330492	21
40	9.5672689	9.9681781	9.5990908	10.4009092	10.0318219	10.4327311	20
41	9.5675868	9.9681279	9.5994588	10.4005411	10.0318721	10.4324132	19
42	9.5679044	9.9680777	9.5998267	10.4001733	10.0319222	10.4320956	18
43	9.5682217	9.9680274	9.6001943	10.3998057	10.0319726	10.4317783	17
44	9.5685387	9.9679771	9.6005617	10.3994383	10.0320229	10.4314613	16
45	9.5688555	9.9679267	9.6009289	10.3990711	10.0320733	10.4311445	15
46	9.5691721	9.9678763	9.6012958	10.3987042	10.0321237	10.4308279	14
47	9.5694883	9.9678258	9.6016625	10.3983375	10.0321742	10.4305117	13
48	9.5698043	9.9677753	9.6020290	10.3979710	10.0322247	10.4301957	12
49	9.5701200	9.9677247	9.6023953	10.3976047	10.0322753	10.4298800	11
50	9.5704355	9.9676741	9.6027613	10.3972387	10.0323259	10.4295645	10
51	9.5707506	9.9676235	9.6031271	10.3968729	10.0323765	10.4292494	9
52	9.5710656	9.9675728	9.6034927	10.3965073	10.0324272	10.4289344	8
53	9.5713802	9.9675221	9.6038581	10.3961419	10.0324779	10.4286198	7
54	9.5716946	9.9674713	9.6042233	10.3957767	10.0325287	10.4283054	6
55	9.5720087	9.9674205	9.6045882	10.3954118	10.0325795	10.4279913	5
56	9.5723226	9.9673698	9.6049529	10.3950471	10.0326303	10.4276774	4
57	9.5726362	9.9673188	9.6053174	10.3946826	10.0326812	10.4273638	3
58	9.5729495	9.9672679	9.6056817	10.3943183	10.0327321	10.4270505	2
59	9.5732626	9.9672169	9.6060457	10.3939543	10.0327831	10.4267374	1
60	9.5735754	9.9671659	9.6064096	10.3935904	10.0328341	10.4264246	0
		Sine.		Tang		Secant	M

68 *Degrees.*

A Table of Artificial Sines,

22 Degrees.

M	Sine.		Tang		Secant		
0	9.5735754	9.9671659	9.6064096	10.3935904	10.0328341	10.4264246	60
1	9.5738880	9.9671143	9.6067732	10.3932268	10.0328852	10.4261120	59
2	9.5742003	9.9670627	9.6071366	10.3928634	10.0329363	10.4257997	58
3	9.5745123	9.9670125	9.6074997	10.3925003	10.0329875	10.4254877	57
4	9.5748240	9.9669614	9.6078627	10.3921373	10.0330386	10.4251760	56
5	9.5751356	9.9669101	9.6082254	10.3917746	10.0330899	10.4248644	55
6	9.5754468	9.9668583	9.6085880	10.3914120	10.0331412	10.4245532	54
7	9.5757578	9.9668075	9.6089503	10.3910497	10.0331925	10.4242422	53
8	9.5760685	9.9667562	9.6093124	10.3906876	10.0332438	10.4239315	52
9	9.5763790	9.9667048	9.6096742	10.3903258	10.0332952	10.4236210	51
10	9.5766892	9.9666533	9.6100359	10.3899641	10.0333467	10.4233108	50
11	9.5769991	9.9666018	9.6103973	10.3896027	10.0333982	10.4230009	49
12	9.5773088	9.9665503	9.6107586	10.3892414	10.0334497	10.4226912	48
13	9.5776183	9.9664986	9.6111196	10.3888804	10.0335013	10.4223817	47
14	9.5779275	9.9664471	9.6114804	10.3885196	10.0335529	10.4220725	46
15	9.5782364	9.9663954	9.6118409	10.3881591	10.0336046	10.4217636	45
16	9.5785450	9.9663437	9.6122013	10.3877987	10.0336563	10.4214550	44
17	9.5788535	9.9662920	9.6125615	10.3874385	10.0337080	10.4211465	43
18	9.5791616	9.9662402	9.6129214	10.3870786	10.0337598	10.4208384	42
19	9.5794695	9.9661884	9.6132812	10.3867188	10.0338116	10.4205305	41
20	9.5797772	9.9661365	9.6136407	10.3863593	10.0338635	10.4202228	40
21	9.5800845	9.9660846	9.6140000	10.3860000	10.0339154	10.4199155	39
22	9.5803917	9.9660326	9.6143591	10.3856409	10.0339674	10.4196083	38
23	9.5806986	9.9659806	9.6147180	10.3852820	10.0340194	10.4193014	37
24	9.5810052	9.9659285	9.6150766	10.3849234	10.0340715	10.4189948	36
25	9.5813116	9.9658764	9.6154351	10.3845649	10.0341236	10.4186884	35
26	9.5816177	9.9658243	9.6157934	10.3842066	10.0341757	10.4183823	34
27	9.5819236	9.9657721	9.6161514	10.3838486	10.0342279	10.4180764	33
28	9.5822292	9.9657199	9.6165093	10.3834907	10.0342801	10.4177708	32
29	9.5825345	9.9656677	9.6168669	10.3831331	10.0343323	10.4174655	31
30	9.5828397	9.9656153	9.6172243	10.3827757	10.0343847	10.4171603	30
		Sine.		Tang		Secant	M

67 Degrees.

22 *Degrees.*

M	Sine		Tang		Secant		
30	9.5828397	9.9656153	9.6172243	10.3827757	10.0343847	10.4171603	30
31	9.5831445	9.9655630	9.6175815	10.3824185	10.0344370	10.4168555	29
32	9.5834491	9.9655106	9.6179385	10.3820615	10.0344894	10.4165509	28
33	9.5837535	9.9654582	9.6182953	10.3817047	10.0345418	10.4162465	27
34	9.5840576	9.9654057	9.6186519	10.3813481	10.0345943	10.4159424	26
35	9.5843615	9.9653532	9.6190083	10.3809917	10.0346468	10.4156385	25
36	9.5846651	9.9653006	9.6193645	10.3806355	10.0346994	10.4153349	24
37	9.5849685	9.9652480	9.6197205	10.3802795	10.0347520	10.4150315	23
38	9.5852716	9.9651953	9.6200762	10.3799238	10.0348047	10.4147284	22
39	9.5855745	9.9651426	9.6204318	10.3795682	10.0348574	10.4144255	21
40	9.5858771	9.9650899	9.6207872	10.3792128	10.0349101	10.4141229	20
41	9.5861795	9.9650371	9.6211423	10.3788577	10.0349629	10.4138205	19
42	9.5864816	9.9649843	9.6214974	10.3785026	10.0350157	10.4135184	18
43	9.5867835	9.9649314	9.6218520	10.3781480	10.0350686	10.4132165	17
44	9.5870851	9.9648785	9.6222066	10.3777934	10.0351215	10.4129149	16
45	9.5873865	9.9648256	9.6225609	10.3774391	10.0351744	10.4126135	15
46	9.5876876	9.9647726	9.6229150	10.3770850	10.0352274	10.4123124	14
47	9.5879885	9.9647195	9.6232690	10.3767310	10.0352805	10.4120115	13
48	9.5882892	9.9646665	9.6236227	10.3763773	10.0353335	10.4117108	12
49	9.5885896	9.9646133	9.6239763	10.3760237	10.0353867	10.4114104	11
50	9.5888897	9.9645602	9.6243296	10.3756704	10.0354398	10.4111103	10
51	9.5891897	9.9645069	9.6246827	10.3753173	10.0354931	10.4108103	9
52	9.5894893	9.9644537	9.6250356	10.3749644	10.0355463	10.4105107	8
53	9.5897888	9.9644004	9.6253884	10.3746116	10.0355996	10.4102112	7
54	9.5900880	9.9643470	9.6257409	10.3742591	10.0356530	10.4099120	6
55	9.5903869	9.9642937	9.6260932	10.3739068	10.0357063	10.4096131	5
56	9.5906856	9.9642402	9.6264454	10.3735546	10.0357598	10.4093144	4
57	9.5909841	9.9641868	9.6267973	10.3732027	10.0358132	10.4090159	3
58	9.5912823	9.9641332	9.6271491	10.3728509	10.0358668	10.4087177	2
59	9.5915803	9.9640797	9.6275006	10.3724994	10.0359203	10.4084197	1
60	9.5918780	9.9640261	9.6278519	10.3721481	10.0359739	10.4081220	0
		Sine.		Tang		Secant	M

67 *Degrees.*

A Table of Artificial Sines,

23 Degrees.

M	Sine.		Tang		Secant		
0	9.5918780	9.9640261	9.6278519	10.3721481	10.0359739	10.4081220	60
1	9.5921755	9.9639734	9.6282031	10.3717969	10.0360276	10.4078243	59
2	9.5924728	9.9639187	9.6285540	10.3714460	10.0360813	10.4075272	58
3	9.5927698	9.9638650	9.6289048	10.3710952	10.0361350	10.4072302	57
4	9.5930656	9.9638112	9.6282553	10.3707447	10.0361888	10.4069334	56
5	9.5933631	9.9637574	9.6296057	10.3703943	10.0362426	10.4066369	55
6	9.5936594	9.9637036	9.6299558	10 3700442	10.0362964	10.4063466	54
7	9.5939555	9 9636496	9.6303058	10.3696942	10 0363504	10.4060445	53
8	9.5942513	9.9635957	9.6306556	10 3693444	10.0364043	10.4057487	52
9	9.5945469	9.9635417	9.6310052	10.3689948	10.036458	10.4054531	51
10	9.5948422	9.9634877	9 6313545	10.3686455	10 0365123	10.4051578	50
11	9 5951373	9.9634336	9.6317037	10.3682963	10 0365664	10.4048627	49
12	9 5954322	9 9633795	9.6320527	10.3679473	10.0366205	10.4045678	48
13	9.5957268	9.9633253	9 6324015	10.3675985	10.0366747	10.4042732	47
14	9.5960212	9 9632711	9.6327501	10.3672499	10 0367289	10.4039788	46
15	9 5963154	9.9632168	9.6330985	10.3669015	10.0367832	10.4036846	45
16	9.5966093	9 9631625	9.6334468	0.3665532	10 0368375	10.4033907	44
17	9.5969030	9 9631082	9 6337948	10.3662052	10.0368918	10.4030970	43
18	9.5971965	9.9630538	9.6341426	10.3658574	10.0369462	10 4028035	42
19	9.5974897	9.9629994	9.6344903	10.3655097	10.0370006	10.4025103	41
20	9.5977827	9.9629449	9.6348378	10 3651622	10.037055	10.4022175	40
21	9.5980754	9.9628904	9 6351850	0.3648150	10.0371096	10 4019246	39
22	9.5983680	9.9628358	9.6355321	10.3644679	10.0371642	10 4016321	38
23	9.5986602	9.9627812	9.6358790	10.3641210	10.0372188	10.4013298	37
24	9.5989523	9.9627266	9.6362257	10.3637743	10.0372734	10.4010477	36
25	9.5992441	9.9626719	9.6365722	10.3634278	10.0373281	10.4007559	35
26	9.5995357	9.9626172	9.6369185	10.3630815	10.0373828	10.4004643	34
27	9.5998270	9.9625624	9.6272646	10.3627354	10.0374376	10.4001730	33
28	9.6001181	9.9625076	9.6376106	10.3623894	10.0374924	10.4998819	32
29	9.6004090	9.9624527	9.6379563	10.3620437	10.0375473	10.4995910	31
30	9.6006997	9.9623078	9.6383019	10.3616981	10.0376022	10.4993003	30
		Sine.		Tang		Secant	M

66 Degrees.

23 Degrees.

M	Sine.		Tang		Secant		
30	9.6006997	9.9623978	9.6383019	10.3616981	10.0376022	10.3993003	30
31	9.6009901	9.9623428	9.6386473	10.3613527	10.0376572	10.3990099	29
32	9.6012803	9.9622878	9.6389925	10.3610075	10.0377122	10.3987197	28
33	9.6015703	9.9622328	9.6393375	10.3606625	10.0377672	10.3984297	27
34	9.6018600	9.9621777	9.6396823	10.3603177	10.0378223	10.3981400	26
35	9.6021495	9.9621226	9.6400269	10.3599731	10.0378774	10.3978505	25
36	9.6024388	9.9620674	9.6403714	10.3596286	10.0379326	10.3975612	24
37	9.6027278	9.9620122	9.6407156	10.3592844	10.0379878	10.3972722	23
38	9.6030166	9.9619569	9.6410597	10.3589403	10.0380431	10.3969834	22
39	9.6033052	9.9619016	9.6414036	10.3585964	10.0380984	10.3966948	21
40	9.6035936	9.9618463	9.6417473	10.3582527	10.0381537	10.3964064	20
41	9.6038817	9.9617909	9.6420908	10.3579092	10.0382091	10.3961183	19
42	9.6041696	9.9617355	9.6424342	10.3575658	10.0382645	10.3958304	18
43	9.6044573	9.9616800	9.6427773	10.3572227	10.0383200	10.3955427	17
44	9.6047448	9.9616245	9.6431203	10.3568797	10.0383755	10.3952522	16
45	9.6050320	9.9615689	9.6434631	10.3565370	10.0384311	10.3949680	15
46	9.6053190	9.9615133	9.6438057	10.3561943	10.0384867	10.3946810	14
47	9.6056057	9.9614576	9.6441481	10.3558519	10.0385424	10.3943943	13
48	9.6058923	9.9614020	9.6444903	10.3555097	10.0385980	10.3941077	12
49	9.6061786	9.9613463	9.6448324	10.3551676	10.0386538	10.3938214	11
50	9.6064647	9.9612904	9.6451743	10.3548257	10.0387096	10.3935353	10
51	9.6067506	9.9612346	9.6455160	10.3544840	10.0387654	10.3932494	9
52	9.6070362	9.9611787	9.6458575	10.3541425	10.0388213	10.3929638	8
53	9.6073216	9.9611228	9.6461988	10.3538012	10.0388772	10.3926784	7
54	9.6076068	9.9610668	9.6465400	10.3534600	10.0389332	10.3923932	6
55	9.6078918	9.9610108	9.6468810	10.3531190	10.0389892	10.3921082	5
56	9.6081765	9.9609548	9.6472217	10.3527783	10.0390452	10.3918235	4
57	9.6084611	9.9608987	9.6475624	10.3524376	10.0391013	10.3915389	3
58	9.6087454	9.9608426	9.6479028	10.3520972	10.0391574	10.3912546	2
59	9.6090294	9.9607864	9.6482431	10.3517569	10.0392136	10.3909706	1
60	9.6093133	9.9607302	9.6485831	10.3514169	10.0392698	10.3906867	0
		Sine.		Tang		Secant	M

66 Degrees.

A Table of Artificial Sines,

24 Degrees.

M	Sine.		Tang		Secant		
0	9.6093133	9.9607302	9.6485831	10.3514169	10.0392698	10 3906867	60
1	9.6095966	9.9606739	9.6489230	10.3510770	10.0393261	10.3904031	59
2	9.6098803	9.9606176	9.6492628	10.3507372	10.0393824	10.3901197	58
3	9.6101635	9.9605612	9.6496023	10.3503977	10.0394388	10.3898365	57
4	9.6104465	9.9605048	9.6499417	10.3500583	10.0394952	10.3895535	56
5	9.6107293	9.9604484	9.6502809	10.3497191	10.0395516	10.3892707	55
6	9.6110118	9.9603919	9.6506199	10.3493801	10.0396081	10.3889882	54
7	9.6112941	9.9603354	9.6509587	10.3490413	10.0396646	10.3887059	53
8	9.6115762	9.9602788	9.6512974	10.3487026	10.0397212	10.3884238	52
9	9.6118580	9.9602222	9.6516359	10.3483641	10.0397778	10.3881420	51
10	9.6121397	9.9601655	9.6519742	10.3480258	10.0398345	10.3878603	50
11	9.6124211	9.9601088	9.6523123	10.3476877	10.0398912	10.3875789	49
12	9.6127023	9.9600520	9.6526503	10.3473497	10.0399480	10.3872977	48
13	9.6129833	9.9599952	9.6529881	10.3470119	10.0400048	10.3870167	47
14	9.6132641	9.9599384	9.6533257	10.3466743	10.0400616	10.3867359	46
15	9.6135446	9.9598815	9.6536631	10.3463369	10.0401185	10.3864554	45
16	9.6138250	9.9598246	9.6540004	10.3459996	10.0401754	10.3861750	44
17	9 6141051	9.9597676	9.6543375	10.3456625	10.0402324	10.3858949	43
18	9.6143850	9.9597106	9.6546744	10.3453256	10.0402894	10.3856150	42
19	9.6146647	9.9596535	9.6550112	10.3449888	10.0403465	10.3853353	41
20	9.6149441	9.9595964	9.6553477	10.3446523	10.0404036	10.3850559	40
21	9.6152234	9.9595393	9.6556841	10.3443159	10.0404607	10.3847766	39
22	9.6155024	9.9594821	9.6560204	10.3439796	10.0405179	10.3844976	38
23	9.6157812	9.9594248	9.6563564	10.3436436	10.0405752	10.3842188	37
24	9.6160598	9.9593675	9.6566923	10.3433077	10.0406325	10.3839401	36
25	9.6163382	9.9593102	9.6570280	10.3429720	10.0406898	10.3836618	35
26	9.6166164	9.9592528	9.6573636	10.3426364	10.0407472	10.3833836	34
27	9.6168944	9.9591954	9.6576989	10.3423011	10.0408046	10.3831056	33
28	9.6171721	9.9591380	9.6580341	10.3419659	10.0408620	10.3828279	32
29	9.6174496	9.9590805	9.6583692	10.3416308	10.0409195	10.3825504	31
30	9.6177270	9.9590229	9.6587041	10.3412960	10.0409771	10.3822730	30
		Sine.		Tang		Secant	M

65 Degrees.

24 Degrees.

M	Sine.		Tang		Secant		
30	9.6177270	9.9590229	9.6587041	10.3412960	10.0409771	10.3822730	30
31	9.6180041	9.9589653	9.6590387	10.3409613	10.0410347	10.3819959	29
32	9.6182809	9.9589077	9.6593733	10.3406267	10.0410923	10.3817191	28
33	9.6185576	9.9588500	9.6597076	10.3402924	10.0411500	10.3814424	27
34	9.6188341	9.9587923	9.6600418	10.3399582	10.0412077	10.3811659	26
35	9.6191103	9.9587345	9.6603758	10.3396242	10.0412655	10.3808897	25
36	9.6193864	9.9586767	9.6607097	10.3392903	10.0413233	10.3806136	24
37	9.6196622	9.9586188	9.6610434	10.3389566	10.0413812	10.3803378	23
38	9.6199378	9.9585609	9.6613769	10.3386231	10.0414391	10.3800622	22
39	9.6202132	9.9585030	9.6617103	10.3382897	10.0414970	10.3797868	21
40	9.6204884	9.9584450	9.6620434	10.3379566	10.0415550	10.3795116	20
41	9.6207634	9.9583869	9.6623765	10.3376235	10.0416131	10.3792366	19
42	9.6210382	9.9583288	9.6627093	10.3372907	10.0416712	10.3789618	18
43	9.6213127	9.9582707	9.6630420	10.3369580	10.0417293	10.3786837	17
44	9.6215871	9.9582125	9.6633745	10.3366255	10.0417875	10.3784129	16
45	9.6218612	9.9581543	9.6637069	10.3362931	10.0418457	10.3781388	15
46	9.6221351	9.9580961	9.6640391	10.3359609	10.0419039	10.3778649	14
47	9.6224088	9.9580378	9.6643711	10.3356289	10.0419622	10.3775912	13
48	9.6226824	9.9579794	9.6647030	10.3352970	10.0420206	10.3773176	12
49	9.6229557	9.9579210	9.6650346	10.3349654	10.0420790	10.3770443	11
50	9.6232287	9.9578626	9.6653662	10.3346338	10.0421374	10.3767713	10
51	9.6235016	9.9578041	9.6656975	10.3343025	10.0421959	10.3764984	9
52	9.6237743	9.9577456	9.6660288	10.3339712	10.0422544	10.3762257	8
53	9.6240468	9.9576870	9.6663598	10.3336402	10.0423130	10.3759532	7
54	9.6243190	9.9576284	9.6666907	10.3333093	10.0423716	10.3756810	6
55	9.6245911	9.9575697	9.6670214	10.3329786	10.0424303	10.3754089	5
56	9.6248629	9.9575110	9.6673519	10.3326481	10.0424890	10.3751371	4
57	9.6251346	9.9574522	9.6676823	10.3323177	10.0425478	10.3748654	3
58	9.6254060	9.9573934	9.6680126	10.3319874	10.0426066	10.3745940	2
59	9.6256772	9.9573346	9.6683426	10.3316574	10.0426654	10.3743228	1
60	9.6259483	9.9572757	9.6686725	10.3313275	10.0427243	10.3740517	0
		Sine.		Tang.		Secant	M

65 Degrees.

A Table of Artificial Sines,

25 Degrees.

M	Sine.		Tang		Secant		
0	9.6259483	9.9572757	9.6686725	10.3313275	10.0427243	10.3740517	60
1	9.6262191	9.9572168	9.6690023	10.3309977	10.0427832	10.3737809	59
2	9.6264897	9.9571578	9.6693319	10.3306681	10.0428422	10.3735103	58
3	9.6267601	9.9570988	9.6696613	10.3303387	10.0429012	10.3732399	57
4	9.6270303	9.9570397	9.6699906	10.3300094	10.0429603	10.3729697	56
5	9.6273003	9.9569806	9.6703197	10.3296803	10.0430194	10.3726997	55
6	9.6275701	9.9569215	9.6706486	10.3293514	10.0430787	10.3724299	54
7	9.6278397	9.9568623	9.6709774	10.3290226	10.0431377	10.3721603	53
8	9.6281090	9.9568030	9.6713060	10.3286940	10.0431970	10.3718910	52
9	9.6283782	9.9567437	9.6716345	10.3283655	10.0432563	10.3716218	51
10	9.6286472	9.9566844	9.6719628	10.3280372	10.0433156	10.3713528	50
11	9.6289160	9.9566250	9.6722910	10.3277090	10.0433750	10.3710840	49
12	9.6291845	9.9565656	9.6726190	10.3273810	10.0434344	10.3708155	48
13	9.6294529	9.9565061	9.6729468	10.3270532	10.0434939	10.3705471	47
14	9.6297211	9.9564466	9.6732745	10.3267255	10.0435534	10.3702789	46
15	9.6299890	9.9563870	9.6736020	10.3263980	10.0436130	10.3700110	45
16	9.6302568	9.9563274	9.6739294	10.3260706	10.0436726	10.3697432	44
17	9.6305243	9.9562678	9.6742566	10.3257434	10.0437322	10.3694757	43
18	9.6307917	9.9562081	9.6745836	10.3254164	10.0437919	10.3692083	42
19	9.6310589	9.9561483	9.6749105	10.3250895	10.0438517	10.3689411	41
20	9.6313258	9.9560886	9.6752372	10.3247628	10.0439114	10.3686742	40
21	9.6315926	9.9560287	9.6755638	10.3244362	10.0439713	10.3684074	39
22	9.6318591	9.9559689	9.6758903	10.3241097	10.0440311	10.3681409	38
23	9.6321255	9.9559089	9.6762165	10.3237835	10.0440911	10.3678745	37
24	9.6323916	9.9558490	9.6765426	10.3234574	10.0441510	10.3676084	36
25	9.6326576	9.9557890	9.6768686	10.3231314	10.0442110	10.3673424	35
26	9.6329233	9.9557289	9.6771944	10.3228056	10.0444711	10.3670767	34
27	9.6331889	9.9556688	9.6775201	10.3224799	10.0443312	10.3668111	33
28	9.6334542	9.9556087	9.6778456	10.3221544	10.0443913	10.3665458	32
29	9.6337194	9.9555485	9.6781709	10.3218291	10.0444515	10.3662806	31
30	9.6339844	9.9554882	9.6784961	10.3215039	10.0445118	10.3660156	30
		Sine.		Tang		Secant	M

64 Degrees.

25 Degrees.

M	Sine.		Tang		Secant		
30	9.6339844	9.9554882	9.6784961	10.3215039	10.0445118	10.3660156	30
31	9.6342491	9.9554280	9.6788211	10.3211789	10.0445720	10.3657509	29
32	9.6345137	9.9553676	9.6791460	10.3208540	10.0446324	10.3654863	28
33	9.6347780	9.9553073	9.6794708	10.3205292	10.0446927	10.3652220	27
34	9.6350422	9.9552469	9.6797953	10.3202047	10.0447531	10.3649578	26
35	9.6353062	9.9551864	9.6801198	10.3198802	10.0448136	10.3646938	25
36	9.6355699	9.9551259	9.6804440	10.3195560	10.0448741	10.3644301	24
37	9.6358335	9.9550653	9.6807682	10.3192318	10.0449347	10.3641665	23
38	9.6360969	9.9550047	9.6810921	10.3189079	10.0449953	10.3639031	22
39	9.6363601	9.9549441	9.6814160	10.3185840	10.0450559	10.3636399	21
40	9.6366231	9.9548834	9.6817396	10.3182604	10.0451166	10.3633760	20
41	9.6368859	9.9548227	9.6820632	10.3179368	10.0451773	10.3631141	19
42	9.6371484	9.9547619	9.6823865	10.3176135	10.0452381	10.3628516	18
43	9.6374108	9.9547011	9.6827098	10.3172902	10.0452989	10.3625892	17
44	9.6376731	9.9546402	9.6830328	10.3169672	10.0453589	10.3623269	16
45	9.6379351	9.9545793	9.6833557	10.3166443	10.0454207	10.3620649	15
46	9.6381969	9.9545184	9.6836785	10.3163215	10.0454816	10.3618031	14
47	9.6384585	9.9544574	9.6840011	10.3159989	10.0455426	10.3615415	13
48	9.6387199	9.9543963	9.6843236	10.3156764	10.0456037	10.3612801	12
49	9.6389812	9.9543352	9.6846459	10.3153541	10.0456648	10.3610188	11
50	9.6392422	9.9542741	9.6849681	10.3150319	10.0457259	10.3607578	10
51	9.6395030	9.9542129	9.6852901	10.3147099	10.0457871	10.3604970	9
52	9.6397637	9.9541517	9.6856120	10.3143880	10.0458483	10.3602363	8
53	9.6400241	9.9540904	9.6859338	10.3140662	10.0459096	10.3599759	7
54	9.6402844	9.9540291	9.6862553	10.3137447	10.0459709	10.3597156	6
55	9.6405445	9.9539677	9.6865768	10.3134232	10.0460323	10.3594555	5
56	9.6408044	9.9539063	9.6868981	10.3131019	10.0460937	10.3591956	4
57	9.6410640	9.9538448	9.6872192	10.3127808	10.0461552	10.3589360	3
58	9.6413235	9.9537833	9.6875402	10.3124598	10.0462167	10.3586765	2
59	9.6415828	9.9537218	9.6878611	10.3121389	10.0462782	10.3584172	1
60	9.6418420	9.9536602	9.6881818	10.3118182	10.0463398	10.3581580	0
		Sine.		Tang		Secant	M

64 Degrees.

A Table of Artificial Sines,

26 Degrees.

M	Sine.		Tang		Secant		
0	9.6418420	9.9536602	9.6881818	10.3118182	10.0463398	10.3581580	60
1	9.6421009	9.9535985	9.6885023	10.3114977	10.0464015	10.3578991	59
2	9.6423596	9.9535369	9.6888227	10.3111773	10.0464631	10.3576404	58
3	9.6426182	9.9534751	9.6891430	10.3108570	10.0465249	10.3573818	57
4	9.6428765	9.9534134	9.6894631	10.3105369	10.0465866	10.3571235	56
5	9.6431347	9.9533515	9.6897831	10.3102169	10.0466485	10.3568653	55
6	9.6433926	9.9532897	9.6901030	10.3098970	10.0467103	10.3566074	54
7	9.6436504	9 9532278	9.6904226	10.3095774	10.0467722	10.3563496	53
8	9.6439080	9.9531658	9.6907422	10.3092578	10.0468342	10.3560920	52
9	9.6441654	9.9531038	9.6910616	10.3089384	10.0468962	10.3558346	51
10	9.6444226	9.9530418	9.6913809	10.3086191	10.0469582	10.3555774	50
11	9.6446796	9.9529797	9.6917000	10.3083000	10.0470203	10.3553204	49
12	9.6449365	9.9529175	9.6920189	10.3079811	10.0470825	10.3550635	48
13	9.6451931	9.9528553	9.6923378	10.3076622	10.0471447	10.3548069	47
14	9.6454496	9.9527931	9.6926565	10.3073435	10.0472069	10.3545504	46
15	9.6457058	9.9527308	9.6929750	10.3070250	10.0472692	10.3542942	45
16	9.6459619	9.9526685	9.6932934	10.3067066	10.0473315	10.3540381	44
17	9.6462178	9.9526061	9.6936117	10.3063883	10.0473939	10.3537822	43
18	9.6464735	9.9525437	9.6939298	10.3060702	10.0474563	10.3535265	42
19	9.6467290	9.9524813	9.6942478	10.3057522	10.0475187	10.3532710	41
20	9.6469844	9.9524188	9.6945656	10.3054344	10.0475812	10.3530156	40
21	9.6472395	9.9523562	9.6948833	10.3051167	10.0476438	10.3527605	39
22	9.6474945	9.9522936	9.6952009	10.3047991	10.0477064	10.3525055	38
23	9.6477492	9.9522310	9.6955183	10.3044817	10.0477690	10.3522508	37
24	9.6480038	9.9521683	9.6958355	10.3041645	10.0478317	10.3519962	36
25	9.6482582	9.9521055	9.6961527	10.3038473	10.0478945	10.3517418	35
26	9.6485124	9.9520428	9.6964697	10.3035303	10.0479572	10.3514876	34
27	9.6487665	9.9519799	9.6967865	10.3032135	10.0480201	10.3512335	33
28	9.6490203	9.9519171	9.6971032	10.3028968	10.0480829	10.3509797	32
29	9.6492740	9.9518541	9.6974198	10.3025802	10.0481459	10.3507260	31
30	9.6495274	9.9517912	9.6977363	10.3022637	10.0482088	10.3504726	30
		Sine.		Tang		Secant	M

63 Degrees.

26 Degrees.

M	Sine		Tang		Secant		
30	9.6495274	9.9517912	9.6977363	10.3022637	10.0482088	10.3504726	30
31	9.6497807	9.9517282	9.6980526	10.3019474	10.0482718	10.3502193	29
32	9.6500338	9.9516651	9.6983687	10.3016313	10.0483349	10.3499662	28
33	9.6502868	9.9516020	9.6986847	10.3013153	10.0483980	10.3497132	27
34	9.6505395	9.9515389	9.6990006	10.3009994	10.0484611	10.3494605	26
35	9.6507920	9.9514757	9.6993164	10.3006836	10.0485243	10.3492080	25
36	9.6510444	9.9514124	9.6996320	10.3003680	10.0485876	10.3489556	24
37	9.6512966	9.9513492	9.6999474	10.3000526	10.0486508	10.3487034	23
38	9.6515486	9.9512858	9.7002628	10.2997372	10.0487142	10.3484514	22
39	9.6518004	9.9512224	9.7005780	10.2994220	10.0487776	10.3481966	21
40	9.6520521	9.9511590	9.7008930	10.2991070	10.0488410	10.3479479	20
41	9.6523035	9.9510956	9.7012080	10.2987920	10.0489044	10.3476965	19
42	9.6525548	9.9510320	9.7015227	10.2984773	10.0489680	10.3474452	18
43	9.6528059	9.9509685	9.7018374	10.2981626	10.0490315	10.3471941	17
44	9.6530568	9.9509049	9.7021519	10.2978481	10.0490951	10.3469432	16
45	9.6533075	9.9508412	9.7024663	10.2975337	10.0491588	10.3466925	15
46	9.6535581	9.9507775	9.7027805	10.2972195	10.0492225	10.3464419	14
47	9.6538084	9.9507138	9.7030946	10.2969054	10.0492862	10.3461916	13
48	9.6540586	9.9506500	9.7034086	10.2965914	10.0493500	10.3459414	12
49	9.6543086	9.9505861	9.7037225	10.2962775	10.0494139	10.3456914	11
50	9.6545584	9.9505223	9.7040362	10.2959638	10.0494777	10.3454416	10
51	9.6548081	9.9504583	9.7043497	10.2956503	10.0495417	10.3451919	9
52	9.6550575	9.9503944	9.7046632	10.2953368	10.0496056	10.3449425	8
53	9.6553068	9.9503303	9.7049765	10.2950235	10.0496697	10.3446932	7
54	9.6555559	9.9502663	9.7052897	10.2947103	10.0496337	10.3444441	6
55	9.6558048	9.9502022	9.7056027	10.2943973	10.0497978	10.3441952	5
56	9.6560536	9.9501380	9.7059156	10.2940844	10.0498620	10.3439404	4
57	9.6563021	9.9500738	9.7062284	10.2937716	10.0499262	10.3436979	3
58	9.6565505	9.9500095	9.7065410	10.2934590	10.0499905	10.3434495	2
59	9.6567987	9.9499452	9.7068535	10.2931465	10.0500548	10.3432013	1
60	9.6570468	9.9498809	9.7071659	10.2928341	10.0501191	10.3429532	0
		Sine.		Tang		Secant	M

63 Degrees.

A Table of Artificial Sines,

27 *Degrees.*

M	Sine.		Tang		Secant		
0	9.6570468	9.9498809	9.7071659	10.2928341	10.0501191	10.3429532	60
1	9.6572946	9.9498165	9.7074781	10.2925219	10.0501835	10.3427054	59
2	9.6575423	9.9497521	9.7077902	10.2922098	10.0502479	10.3424577	58
3	9.6577898	9.9496876	9.7081022	10.2918978	10.0503124	10.3422102	57
4	9.6580371	9.9496230	9.7084141	10.2915859	10.0503770	10.3419629	56
5	9.6582842	9.9495585	9.7087258	10.2912742	10.0504415	10.3417158	55
6	9.6585312	9.9494938	9.7090374	10.2909626	10.0505062	10.3414688	54
7	9.6587780	9.9494292	9.7093488	10.2906512	10.0505708	10.3412220	53
8	9.6590246	9.9493645	9.7096601	10.2903399	10.0506355	10.3409754	52
9	9.6592710	9.9492997	9.7099713	10.2900287	10.0507003	10.3407290	51
10	9.6595173	9.9492349	9.7102824	10.2897176	10.0507651	10.3404827	50
11	9.6597634	9.9491700	9.7105933	10.2894067	10.0508300	10.3402367	49
12	9.6600093	9.9491051	9.7109041	10.2890959	10.0508949	10.3399907	48
13	9.6602550	9.9490402	9.7112148	10.2887852	10.0509598	10.3397450	47
14	9.6605005	9.9489752	9.7115254	10.2884746	10.0510248	10.3394995	46
15	9.6607459	9.9489101	9.7118358	10.2881642	10.0510899	10.3392541	45
16	9.6609911	9.9488450	9.7121461	10.2878539	10.0511500	10.3390089	44
17	9.6612361	9.9487799	9.7124562	10.2875438	10.0512201	10.3387639	43
18	9.6614810	9.9487147	9.7127662	10.2872338	10.0512853	10.3385190	42
19	9.6617257	9.9486495	9.7130761	10.2869239	10.0513505	10.3382743	41
20	9.6619701	9.9485842	9.7133859	10.2866141	10.0514158	10.3380298	40
21	9.6622145	9.9485189	9.7136956	10.2863044	10.0514811	10.3377855	39
22	9.6624586	9.9484535	9.7140051	10.2859949	10.0515465	10.3375414	38
23	9.6627026	9.9483881	9.7143145	10.2856855	10.0516119	10.3372974	37
24	9.6629464	9.9483227	9.7146237	10.2853763	10.0516773	10.3370536	36
25	9.6631900	9.9482572	9.7149329	10.2850671	10.0517428	10.3368100	35
26	9.6634335	9.9481916	9.7152419	10.2847581	10.0518084	10.3365665	34
27	9.6636768	9.9481260	9.7155508	10.2844492	10.0518740	10.3363232	33
28	9.6639199	9.9480604	9.7158595	10.2841405	10.0519396	10.3360801	32
29	9.6641628	9.9479947	9.7161682	10.2838318	10.0520053	10.3358372	31
30	9.6644056	9.9479289	9.7164767	10.2835233	10.0520711	10.3355944	30
		Sine.		Tang		Secant	M

62 *Degrees.*

27 Degrees.

M	Sine.		Tang		Secant		
30	9.6644056	9.9479289	9.7164767	10.2835233	10.0520711	10.3355944	30
31	9.6646482	9.9478631	9.7167851	10.2832149	10.0521369	10.3353518	29
32	9.6648906	9.9477973	9.7170933	10.2829067	10.0522027	10.3351094	28
33	9.6651329	9.9477314	9.7174014	10.2825986	10.0522686	10.3348671	27
34	9.6653749	9.9476655	9.7177094	10.2822906	10.0523345	10.3346251	26
35	9.6656168	9.9475995	9.7180173	10.2819827	10.0524005	10.3343832	25
36	9.6658586	9.9475335	9.7183251	10.2816749	10.0524665	10.3341414	24
37	9.6661001	9.9474674	9.7186327	10.2813673	10.0525326	10.3338999	23
38	9.6663415	9.9474013	9.7189402	10.2810598	10.0525987	10.3336585	22
39	9.6665828	9.9473352	9.7192476	10.2807524	10.0526648	10.3334172	21
40	9.6668238	9.9472689	9.7195549	10.2804451	10.0527311	10.3331762	20
41	9.6670647	9.9472027	9.7198620	10.2801380	10.0527973	10.3329353	19
42	9.6673054	9.9471364	9.7201690	10.2798310	10.0528636	10.3326946	18
43	9.6675459	9.9470700	9.7204759	10.2795241	10.0529300	10.3324541	17
44	9.6677863	9.9470036	9.7207827	10.2792173	10.0529964	10.3322137	16
45	9.6680265	9.9469372	9.7210893	10.2789107	10.0530628	10.3319735	15
46	9.6682665	9.9468707	9.7213958	10.2786042	10.0531293	10.3317335	14
47	9.6685064	9.9468042	9.7217022	10.2782978	10.0531958	10.3314936	13
48	9.6687461	9.9467376	9.7220085	10.2779915	10.0532624	10.3312539	12
49	9.6689856	9.9466710	9.7223147	10.2776853	10.0533290	10.3310144	11
50	9.6692250	9.9466043	9.7226207	10.2773793	10.0533957	10.3307750	10
51	9.6694642	9.9465376	9.7229266	10.2770734	10.0534624	10.3305358	9
52	9.6697032	9.9464708	9.7232324	10.2767676	10.0535292	10.3302968	8
53	9.6699420	9.9464040	9.7235381	10.2764619	10.0535960	10.3300580	7
54	9.6701807	9.9463371	9.7238436	10.2761564	10.0536629	10.3298193	6
55	9.6704192	9.9462702	9.7241490	10.2758510	10.0537298	10.3295808	5
56	9.6706576	9.9462032	9.7244543	10.2755457	10.0537968	10.3293424	4
57	9.6708958	9.9461362	9.7247595	10.2752405	10.0538938	10.3291042	3
58	9.6711338	9.9460692	9.7250646	10.2749354	10.0539308	10.3288662	2
59	9.6713716	9.9460021	9.7253695	10.2746305	10.0539979	10.3286284	1
60	9.6716093	9.9459349	9.7256744	10.2743256	10.0540651	10.3283907	0
		Sine.		Tang		Secant	M

62 Degrees.

A Table of Artificial Sines,

28 *Degrees.*

M	Sine		Tang		Secant		
0	9.6716093	9.9459349	9.7256744	10.2743256	10.0540651	10.3283907	60
1	9.6718468	9.9458677	9.7259791	10.2740209	10.0541323	10.3281532	59
2	9.6720841	9.9458005	9.7262836	10.2737163	10.0541995	10.3279159	58
3	9.6723213	9.9457332	9.7265881	10.2734119	10.0542668	10.3276787	57
4	9.6725583	9.9456659	9.7268925	10.2731075	10.0543341	10.3274417	56
5	9.6727952	9.9455985	9.7271967	10.2728033	10.0544015	10.3272048	55
6	9.6730319	9.9455310	9.7275008	10.2724992	10.0544690	10.3269681	54
7	9.6732684	9.9454636	9.7278048	10.2721952	10.0545364	10.3267316	53
8	9.6735047	9.9453960	9.7281087	10.2718913	10.0546040	10.3264953	52
9	9.6737409	9.9453285	9.7284124	10.2715876	10.0546715	10.3262591	51
10	9.6739769	9.9452609	9.7287161	10.2712839	10.0547391	10.3260231	50
11	9.6742128	9.9451932	9.7290196	10.2709804	10.0548068	10.3257872	49
12	9.6744485	9.9451255	9.7293230	10.2706770	10.0548745	10.3255515	48
13	9.6746840	9.9450577	9.7296263	10.2703737	10.0549423	10.3253160	47
14	9.6749194	9.9449899	9.7299295	10.2700705	10.0550101	10.3250806	46
15	9.6751546	9.9449220	9.7302325	10.2697675	10.0550780	10.3248454	45
16	9.6753896	9.9448541	9.7305354	10.2694646	10.0551459	10.3246104	44
17	9.6756245	9.9447862	9.7308383	10.2691617	10.0552138	10.3243756	43
18	9.6758592	9.9447182	9.7311410	10.2688590	10.0552818	10.3241408	42
19	9.6760937	9.9446501	9.7314436	10.2685564	10.0553499	10.3239063	41
20	9.6763281	9.9445821	9.7317460	10.2682540	10.0554179	10.3236719	40
21	9.6765623	9.9445139	9.7320484	10.2679516	10.0554861	10.3234377	39
22	9.6767963	9.9444457	9.7323506	10.2676494	10.0555543	10.3232037	38
23	9.6770302	9.9443775	9.7326527	10.2673473	10.0556225	10.3229698	37
24	9.6772640	9.9443092	9.7329547	10.2670453	10.0556908	10.3227360	36
25	9.6774975	9.9442409	9.7332566	10.2667434	10.0557591	10.3225025	35
26	9.6777309	9.9441725	9.7335584	10.2664416	10.0558275	10.3222691	34
27	9.6779642	9.9441042	9.7338601	10.2661399	10.0558959	10.3220358	33
28	9.6781972	9.9440356	9.7341616	10.2658384	10.0559644	10.3218028	32
29	9.6784301	9.9439671	9.7344631	10.2655369	10.0560329	10.3215699	31
30	9.6786629	9.9438985	9.7347644	10.2652356	10.0561015	10.3213371	30
		Sine.		Tang		Secant	M

61 *Degrees.*

28 Degrees.

M	Sine.		Tang		Secant		
30	9.6786629	9.9438985	9.7347644	10.2652356	10.0561015	10.3213371	30
31	9.6788955	9.9438299	9.7350656	10.2649344	10.0561701	10.3211045	29
32	9.6791279	9.9437612	9.7353667	10.2646333	10.0562388	10.3208721	28
33	9.6793602	9.9436925	9.7356677	10.2643323	10.0563075	10.3206398	27
34	9.6795923	9.9436238	9.7359685	10.2640315	10.0563762	10.3204077	26
35	9.6798243	9.9435549	9.7362693	10.2637307	10.0564451	10.3201757	25
36	9.6800560	9.9434861	9.7365699	10.2634301	10.0565139	10.3199440	24
37	9.6802877	9.9434172	9.7368705	10.2631195	10.0565828	10.3197123	23
38	9.6805191	9.9433482	9.7371709	10.2628291	10.0566518	10.3194809	22
39	9.6807504	9.9432792	9.7374712	10.2625288	10.0567208	10.3192496	21
40	9.6809816	9.9432102	9.7377714	10.2622286	10.0567898	10.3190184	20
41	9.6812126	9.9431411	9.7380715	10.2619285	10.0568589	10.3187874	19
42	9.6814434	9.9430720	9.7383714	10.2616286	10.0569280	10.3185566	18
43	9.6816741	9.9430028	9.7386713	10.2613287	10.0569972	10.3183259	17
44	9.6819046	9.9429335	9.7389710	10.2610290	10.0570665	10.3180954	16
45	9.6821349	9.9428643	9.7392707	10.2607293	10.0571357	10.3178651	15
46	9.6823651	9.9427949	9.7395702	10.2604298	10.0572051	10.3176349	14
47	9.6825952	9.9427255	9.7398696	10.2601304	10.0572745	10.3174048	13
48	9.6828250	9.9426561	9.7401689	10.2598311	10.0573439	10.3171750	12
49	9.6830548	9.9425866	9.7404681	10.2595319	10.0574134	10.3169452	11
50	9.6832843	9.9425171	9.7407672	10.2592328	10.0574829	10.3167157	10
51	9.6835137	9.9424476	9.7410662	10.2589338	10.0575524	10.3164863	9
52	9.6837430	9.9423779	9.7413650	10.2586350	10.0576221	10.3162570	8
53	9.6839720	9.9423083	9.7416638	10.2583362	10.0576917	10.3160280	7
54	9.6842010	9.9422386	9.7419624	10.2580376	10.0577614	10.3157990	6
55	9.6844297	9.9421688	9.7422609	10.2577391	10.0578312	10.3155703	5
56	9.6846583	9.9420990	9.7425594	10.2574406	10.0579010	10.3153417	4
57	9.6848868	9.9420291	9.7428577	10.2571423	10.0579709	10.3151132	3
58	9.6851151	9.9419592	9.7431559	10.2568441	10.0580408	10.3148849	2
59	9.6853432	9.9418893	9.7434540	10.2565460	10.0581107	10.3146568	1
60	9.6855712	9.9418193	9.7437520	10.2562480	10.0581807	10.3144288	0
		Sine.		Tang		Secant	M

61 Degrees.

A Table of Artificial Sines,

29 *Degrees.*

M	Sine.		Tang		Secant		
0	9.6855712	9.9418193	9.7437520	10.2562480	10.0581807	10.3144288	60
1	9.6857991	9.9417492	9.7440499	10.2559501	10.0582508	10.3142009	59
2	9.6860267	9.9416791	9.7443476	10.2556524	10.0583209	10.3139733	58
3	9.6862542	9.9416090	9.7446453	10.2553547	10.0583910	10.3137458	57
4	9.6864816	9.9415388	9.7449428	10.2550572	10.0584612	10.3135184	56
5	9.6867088	9.9414685	9.7452403	10.2547597	10.0585315	10.3132912	55
6	9.6869359	9.9413982	9.7455376	10.2544624	10.0586018	10.3130641	54
7	9.6871628	9.9413279	9.7458349	10.2541651	10.0586721	10.3128372	53
8	9.6873895	9.9412575	9.7461320	10.2538680	10.0587425	10.3126105	52
9	9.6876161	9.9411871	9.7464290	10.2535710	10.0588129	10.3123839	51
10	9.6878425	9.9411166	9.7467259	10.2532741	10.0588834	10.3121575	50
11	9.6880688	9.9410461	9.7470227	10.2529773	10.0589539	10.3119312	49
12	9.6882949	9.9409755	9.7473194	10.2526806	10.0590245	10.3117051	48
13	9.6885209	9.9409048	9.7476160	10.2523840	10.0590952	10.3114791	47
14	9.6887467	9.9408342	9.7479125	10.2520875	10.0591658	10.3112533	46
15	9.6889723	9.9407634	9.7482089	10.2517911	10.0592366	10.3110277	45
16	9.6891978	9.9406927	9.7485052	10.2514948	10.0593073	10.3108022	44
17	9.6894232	9.9406219	9.7488013	10.2511987	10.0593781	10.3105768	43
18	9.6896484	9.9405510	9.7490974	10.2509026	10.0594490	10.3103516	42
19	9.6898734	9.9404801	9.7493934	10.2506066	10.0595199	10.3101266	41
20	9.6900983	9.9494091	9.7496892	10.2503108	10.0595909	10.3099017	40
21	9.6903231	9.9403381	9.7499850	10.2500150	10.0596619	10.3096769	39
22	9.6905476	9.9402670	9.7502806	10.2497194	10.0597330	10.3094524	38
23	9.6907721	9.9401959	9.7505762	10.2494238	10.0598041	10.3092279	37
24	9.6909964	9.9401248	9.7508716	10.2491284	10.0598752	10.3090036	36
25	9.6912205	9.9400535	9.7511669	10.2488331	10.0599465	10.3087795	35
26	9.6914445	9.9399823	9.7514622	10.2485378	10.0600177	10.3085555	34
27	9.6916683	9.9399110	9.7517573	10.2482427	10.0600890	10.3083317	33
28	9.6918919	9.9398396	9.7520523	10.2479477	10.0601604	10.3081081	32
29	9.6921155	9.9397682	9.7523472	10.2476528	10.0602318	10.3078845	31
30	9.6923388	9.9396968	9.7526420	10.2473580	10.0603032	10.3076612	30
		Sine.		Tang		Secant	M

60 *Degrees.*

29 *Degrees.*

M	Sine		Tang		Secant		
30	9.6923388	9.9396968	9.7526420	10.2473580	10.0603032	10.3076612	30
31	9.6925620	9.9396253	9.7529368	10.2470632	10.0603747	10.3074380	29
32	9.6927851	9.9395537	9.7532314	10.2467686	10.0604463	10.3072149	28
33	9.6930080	9.9394821	9.7535259	10.2464741	10.0605179	10.3069920	27
34	9.6932308	9.9394105	9.7538203	10.2461797	10.0605895	10.3067692	26
35	9.6934534	9.9393388	9.7541146	10.2458854	10.0606612	10.3065466	25
36	9.6936758	9.9392671	9.7544088	10.2455912	10.0607329	10.3063242	24
37	9.6938981	9.9391953	9.7547029	10.2452971	10.0608047	10.3061019	23
38	9.6941203	9.9391234	9.7549969	10.2450031	10.0608766	10.3058797	22
39	9.6943423	9.9390515	9.7552908	10.2447091	10.0609485	10.305[illegible]77	21
40	9.6945642	9.9389796	9.7555846	10.2444154	10.0610204	10.3054358	20
41	9.6947859	9.9389076	9.7558783	10.2441217	10.0610924	10.3052141	19
42	9.6950074	9.9388356	9.7561718	10.2438282	10.0611644	10.3049926	18
43	9.6952288	9.9387635	9.7564653	10.2435347	10.0612365	10.3047712	17
44	9.6954501	9.9386914	9.7567587	10.2432413	10.0613086	10.3045499	16
45	9.6956712	9.9386192	9.7570520	10.2429480	10.0613808	10.3043288	15
46	9.6958922	9.9385470	9.7573452	10.2426548	10.0614530	10.3041078	14
47	9.6961130	9.9384747	9.7576383	10.2423617	10.0615253	10.3038870	13
48	9.6963336	9.9384024	9.7579313	10.2420687	10.0615976	10.3036664	12
49	9.6965541	9.9383300	9.7582242	10.2417758	10.0616700	10.3034459	11
50	9.6967745	9.9382576	9.7585170	10.2414830	10.0617424	10.3032255	10
51	9.6969947	9.9381851	9.7588096	10.2411904	10.0618149	10.3030053	9
52	9.6972148	9.9381127	9.7591022	10.2408978	10.0618874	10.3027852	8
53	9.6974347	9.9380400	9.7593947	10.2406053	10.0619600	10.3025653	7
54	9.6976545	9.9379674	9.7596871	10.2403129	10.0620326	10.3023455	6
55	9.6978741	9.9378947	9.7599794	10.2400206	10.0621053	10.3021259	5
56	9.6980936	9.9378220	9.7602716	10.2397284	10.0621780	10.3019064	4
57	9.6983129	9.9377492	9.7605637	10.2394363	10.0622508	10.3016871	3
58	9.6985321	9.9376764	9.7608557	10.2391443	10.0623236	10.3014679	2
59	9.6987511	9.9376035	9.7611476	10.2388524	10.0623965	10.3012489	1
60	9.6989700	9.9375306	9.7614394	10.2385606	10.0624694	10.3010300	0
		Sine.		Tang		Secant	M

60 *Degrees.*

A Table of Artificial Sines,

30 Degrees.

M	Sine.		Tang		Secant		
0	9 6989700	9.9375306	9.7614394	10.2385606	10.0624694	10.3010300	60
1	9.6991887	9.9374577	9.7617311	10.2382689	10.0625423	10.3008113	59
2	9.6994073	9.9373847	9.7620227	19.2379773	10.0626153	10.3005927	58
3	9.6996258	9.9373116	9.7623142	10.2376858	10.0626884	10.3003742	57
4	9.6998441	9.9372385	9.7626056	10.2373944	10.0627615	10.3001559	56
5	9.7000622	9.9371653	9.7628969	10.2371031	10.0628347	10.2999378	55
6	9.7002802	9.9370921	9.7631881	10.2368119	10.0629079	10.2997198	54
7	9.7004981	9 9370189	9.7634792	10.2365208	10.0629811	10.2995019	53
8	9.7007158	9.9369456	9.7637702	10.2362298	10.0630544	10.2992842	52
9	9.7009334	9.9368722	9.7640612	10.2359388	10.0631278	10.2990666	51
10	9.7011508	9.9367988	9.7643520	10.2356480	10.0632012	10.2988492	50
11	9.7013681	9.9367254	9.7646427	10.2353573	10.0632746	10.2986319	49
12	9.7015852	9.9366519	9.7649334	10.2350666	10.0633481	10.2984148	48
13	9.7018022	9.9365783	9.7652239	10.2347761	10.0634217	10.2981978	47
14	9.7020190	9.9365047	9.7655143	10.2344857	10.0634953	10.2979810	46
15	9.7022357	9.9364311	9.7658047	10.2341953	10.0635689	10.2977663	45
16	9.7024523	9.9363574	9.7660949	10.2339051	10.0636426	10.2975477	44
17	9.7026687	9.9362836	9.7663851	10.2336149	10.0637164	10.2973313	43
18	9.7028849	9.9362098	9.7666751	10.2333249	10.0637902	10.2971151	42
19	9.7031011	9.9361360	9.7669651	10.2330349	10.0638640	10.2968989	41
20	9.7033170	9.9360621	9.7672550	10.2327450	10.0639379	10.2966830	40
21	9.7035329	9.9359881	9.7675448	10.2324552	10.0640119	10.2964671	39
22	9.7037486	9.9359141	9.7678344	10.2321656	10.0640859	10.2962514	38
23	9.7039641	9.9358401	9.7681240	10.2318760	10.0641599	10.2960359	37
24	9.7041795	9.9357660	9.7684135	10.2315865	10.0642340	10.2958205	36
25	9.7043947	9.9356918	9.7687029	10.2312971	10.0643082	10.2956052	35
26	9.7046099	9.9356177	9.7689922	10.2310078	10.0643823	10.2953901	34
27	9.7048248	9.9355434	9.7692814	10.2307186	10.0644566	10.2951752	33
28	9.7050397	9.9354691	9.7695705	10.2304295	10.0645309	10.2949603	32
29	9.7052543	9.9353948	9.7698596	10.2301404	10.0646052	10.2947457	31
30	9.7054689	9.9353204	9.7701485	10.2298515	10.0646796	10.2945311	30
		Sine.		Tang		Secant	M

59 Degrees.

30 Degrees.

M	Sine		Tang		Secant		
30	9.7054689	9.9353204	9.7701485	10.2298515	10.0646796	10.2945311	30
31	9.7056833	9.9352459	9.7704373	10.2295627	10.0647541	10.2943167	29
32	9.7058975	9.9351715	9.7707261	10.2295739	10.0648285	10.2941025	28
33	9.7061116	9.9350969	9.7710147	10.2289853	10.0649031	10.2938884	27
34	9.7063256	9.9350223	9.7713023	10.2286967	10.0649777	10.2936744	26
35	9.7065394	9.9349477	9.7715917	10.2284083	10.0650523	10.2934606	25
36	9.7067531	9.9348730	9.7718801	10.2281199	10.0651270	10.2932469	24
37	9.7069667	9.9347983	9.7721684	10.2278316	10.0652017	10.2930333	23
38	9.7071801	9.9347235	9.7724566	10.2275434	10.0652765	10.2928199	22
39	9.7073933	9.9346486	9.7727447	10.2272553	10.0653514	10.2926067	21
40	9.7076064	9.9345738	9.7730327	10.2269673	10.0654262	10.2923936	20
41	9.7078194	9.9344988	9.7733206	10.2265794	10.0655012	10.2921806	19
42	9.7080323	9.9344238	9.7736084	10.2263916	10.0655762	10.2919677	18
43	9.7082450	9.9343488	9.7738961	10.2261039	10.0656512	10.2917550	17
44	9.7084575	9.9342737	9.7741838	10.2258162	10.0657263	10.2915425	16
45	9.7086699	9.9341986	9.7744713	10.2255287	10.0658014	10.2913301	15
46	9.7088822	9.9341234	9.7747588	10.2252412	10.0658766	10.2911178	14
47	9.7090943	9.9340482	9.7759462	10.2249538	10.0659518	10.2909057	13
48	9.7093063	9.9339729	9.7753334	10.2246666	10.0660271	10.2906937	12
49	9.7095182	9.9338976	9.7756206	10.2243794	10.0661024	10.2904818	11
50	9.7097299	9.9338222	9.7759077	10.2240923	10.0661778	10.2902701	10
51	9.7099415	9.9337467	9.7761947	10.2238053	10.0662533	10.2900585	9
52	9.7101529	9.9336713	9.7764816	10.2235184	10.0663287	10.2898471	8
53	9.7103642	9.9335957	9.7767685	10.2232315	10.0664043	10.2896358	7
54	9.7105753	9.9335201	9.7770552	10.2229448	10.0664799	10.2894247	6
55	9.7107863	9.9334445	9.7773418	10.2226582	10.0665555	10.2892137	5
56	9.7109972	9.9333688	9.7776284	10.2223716	10.0666312	10.2890028	4
57	9.7112080	9.9332931	9.7779149	10.2220851	10.0667069	10.2887920	3
58	9.7114186	9.9332173	9.7782012	10.2217988	10.0667827	10.2885814	2
59	9.7116290	9.9331415	9.7784875	10.2215125	10.0668585	10.2883710	1
60	9.7118393	9.9330656	9.7787737	10.2212263	10.0669344	10.2881607	0
		Sine.		Tang		Secant	M

59 Degrees.

31 Degrees.

M	Sine.		Tang		Secant		
0	9.7118393	9.9330656	9.7787737	10.2212262	10.0669344	10.2881607	60
1	9.7120495	9.9329897	9.7790599	10.2209401	10.0670103	10.2879505	59
2	9.7122596	9.9329137	9.7793459	10.2206541	10.0670863	10.2877404	58
3	9.7124695	9.9328376	9.7796318	10.2203682	10.0671624	10.2875305	57
4	9.7126792	9.9327616	9.7799177	10.2200823	10.0672384	10.2873208	56
5	9.7128889	9.9326854	9.7802034	10.2197966	10.0673146	10.2871111	55
6	9.7130983	9.9326092	9.7804891	10.2195109	10.0673908	10.2869017	54
7	9.7133077	9.9325330	9.7807747	10.2192253	10.0674670	10.2866923	53
8	9.7135169	9.9324567	9.7810602	10.2189398	10.0675433	10.2864831	52
9	9.7137260	9.9323804	9.7813456	10.2186544	10.0676196	10.2862740	51
10	9.7139349	9.9323040	9.7816309	10.2183691	10.0676960	10.2860651	50
11	9.7141437	9.9322276	9.7819162	10.2180838	10.0677724	10.2858563	49
12	9.7143524	9.9321511	9.7822013	10.2177987	10.0678489	10.2856476	48
13	9.7145609	9.9320746	9.7824864	10.2175136	10.0679254	10.2854391	47
14	9.7147693	9.9319980	9.7827713	10.2172287	10.0680020	10.2852307	46
15	9.7149776	9.9319213	9.7830562	10.2169438	10.0680787	10.2850224	45
16	9.7151857	9.9318447	9.7833410	10.2166590	10.0681553	10.2848143	44
17	9.7153937	9.9317679	9.7836258	10.2163742	10.0682321	10.2846063	43
18	9.7156015	9.9316911	9.7839104	10.2160896	10.0683089	10.2843985	42
19	9.7158092	9.9316143	9.7841949	10.2158051	10.0683857	10.2841908	41
20	9.7160168	9.9315374	9.7844794	10.2155206	10.0684626	10.2839832	40
21	9.7162243	9.9314605	9.7847638	10.2152362	10.0685395	10.2837757	39
22	9.7164316	9.9313835	9.7850481	10.2149519	10.0686165	10.2835684	38
23	9.7166387	9.9313065	9.7853323	10.2146677	10.0686935	10.2833613	37
24	9.7168458	9.9312294	9.7856164	10.2143836	10.0687706	10.2831542	36
25	9.7170526	9.9311522	9.7859004	10.2140996	10.0688478	10.2829474	35
26	9.7172594	9.9310750	9.7861844	10.2138156	10.0689250	10.2827406	34
27	9.7174660	9.9309978	9.7864682	10.2135318	10.0690022	10.2825340	33
28	9.7176725	9.9309205	9.7867520	10.2132480	10.0690795	10.2823275	32
29	9.7178789	9.9308432	9.7870357	10.2129643	10.0691568	10.2821211	31
30	9.7180851	9.9307658	9.7873193	10.2126807	10.0692342	10.2819149	30
		Sine.		Tang		Secant	M

58 Degrees.

31 *Degrees.*

M	Sine.		Tang		Secant		
30	9.7180851	9.9307658	9.7873193	10.2126807	10.0692342	10.2819149	30
31	9.7182912	9.9306883	9.7876028	10.2123972	10.0693117	10.2817088	29
32	9.7184971	9.9306109	9.7878863	10.2121137	10.0693891	10.2815029	28
33	9.7187030	9.9305333	9.7881696	10.2118304	10.0694667	10.2812970	27
34	9.7189086	9.9304557	9.7884529	10.2115471	10.0695443	10.2810914	26
35	9.7191142	9.9303781	9.7887361	10.2112639	10.0696219	10.2808858	25
36	9.7193196	9.9303004	9.7890192	10.2109808	10.0696996	10.2806804	24
37	9.7195249	9.9302226	9.7893023	10.2106977	10.0697774	10.2804751	23
38	9.7197300	9.9301448	9.7895852	10.2104148	10.0698552	10.2802700	22
39	9.7199350	9.9300670	9.7898681	10.2101319	10.0699330	10.2800650	21
40	9.7201399	9.9299891	9.7901508	10.2098492	10.0700109	10.2798601	20
41	9.7203447	9.9299112	9.7904335	10.2095665	10.0700888	10.2796553	19
42	9.7205493	9.9298332	9.7907161	10.2092839	10.0701668	10.2794507	18
43	9.7207538	9.9297551	9.7909987	10.2090013	10.0702449	10.2792462	17
44	9.7209581	9.9296770	9.7912811	10.2087189	10.0703230	10.2790419	16
45	9.7211623	9.9295989	9.7915635	10.2084365	10.0704011	10.2788377	15
46	9.7213664	9.9295207	9.7918458	10.2081542	10.0704793	10.2786336	14
47	9.7215704	9.9294424	9.7921280	10.2078720	10.0705576	10.2784296	13
48	9.7217742	9.9293641	9.7924101	10.2075899	10.0706359	10.2782258	12
49	9.7219779	9.9292857	9.7926921	10.2073079	10.0707143	10.2780221	11
50	9.7221814	9.9292073	9.7929741	10.2070259	10.0707927	10.2778186	10
51	9.7223848	9.9291289	9.7932560	10.2067440	10.0708711	10.2776152	9
52	9.7225881	9.9290504	9.7935378	10.2064622	10.0709496	10.2774119	8
53	9.7227913	9.9289718	9.7938195	10.2061805	10.0710283	10.2772087	7
54	9.7229943	9.9288932	9.7941011	10.2058989	10.0711068	10.2770057	6
55	9.7231972	9.9288145	9.7943827	10.2056173	10.0711855	10.2768028	5
56	9.7234000	9.9287358	9.7946641	10.2053359	10.0712643	10.2766030	4
57	9.7236026	9.9286571	9.7949455	10.2050545	10.0713429	10.2763974	3
58	9.7238051	9.9285783	9.7952268	10.2047732	10.0714217	10.2761949	2
59	9.7240075	9.9284994	9.7955081	10.2044919	10.0715006	10.2759925	1
60	9.7242097	9.9284205	9.7957892	10.2042108	10.0715795	10.2757903	0
		Sine.		Tang		Secant	M

58 *Degrees.*

32 Degrees.

M	Sine.		Tang		Secant		
0	9.7242097	9.9284205	9.7957892	10.2042108	10.07 5795	10.2757903	60
1	9.7244118	9.9283415	9.7960703	10.2039297	10.0716585	10.2755882	59
2	9.7246138	9.9282625	9.7963513	10.2036487	10.0717375	10.2753862	58
3	9.7248156	9.9281834	9.7966322	10.2033678	10.0718166	10.2751844	57
4	9.7250174	9.9281043	9.7969130	10.2030870	10.0718957	10.2749826	56
5	9.7252189	9.9280251	9.7971938	10.2028062	10.0719749	10.2747811	55
6	9.7254204	9.9279459	9.7974745	10.2025255	10.0720541	10.2745796	54
7	9.7256217	9.9278666	9.7977552	10.2022449	10.0721334	10.2743783	53
8	9.7258229	9.9277873	9.7980356	10.2019644	10.0722127	10.2741771	52
9	9.7260240	9.9277079	9.7983160	10.2016840	10.0722921	10.2739760	51
10	9.7262249	9.9276285	9.7985964	10.2014036	10.0723715	10.2737751	50
11	9.7264257	9.9275490	9.7988767	10.2011233	10.0724510	10.2735743	49
12	9.7266264	9.9274695	9.7991569	10.2008431	10.0725305	10.2733736	48
13	9.7268269	9.9273899	9.7994370	10.2005630	10.0726101	10.2731731	47
14	9.7270273	9.9273103	9.7997170	10.2002830	10.0726897	10.2729727	46
15	9.7272276	9.9272306	9.7999970	10.2000030	10.0727694	10.2727724	45
16	9.7274278	9.9271509	9.8002769	10.1997231	10.0728491	10.2725722	44
17	9.7276278	9.9270711	9.8005567	10.1994433	10.0729289	10.2723722	43
18	9.7278277	9.9269913	9.8008365	10.1991635	10.0730087	10.2721723	42
19	9.7280275	9.9269114	9.8011161	10.1988839	10.0730886	10.2719725	41
20	9.7282271	9.9268314	9.8013957	10.1986043	10.0731686	10.2717729	40
21	9.7284267	9.9267514	9.8016752	10.1983248	10.0732486	10.2715733	39
22	9.7286260	9.9266714	9.8019546	10.1980454	10.0733286	10.2713740	38
23	9.7288253	9.9265913	9.8022340	10.1977660	10.0734087	10.2711747	37
24	9.7290244	9.9265112	9.8025133	10.1974867	10.0734888	10.2709756	36
25	9.7292234	9.9264310	9.8027925	10.1972075	10.0735690	10.2707766	35
26	9.7294223	9.9263507	9.8030716	10.1969284	10.0736493	10.2705777	34
27	9.7296211	9.9262704	9.8033506	10.1966494	10.0737296	10.2703790	33
28	9.7298197	9.9261901	9.8036296	10.1963704	10.0738099	10.2701803	32
29	9.7300182	9.9261096	9.8039085	10.1960915	10.0738904	10.2699818	31
30	9.7302165	9.9260292	9.8041873	10.1958127	10.0739708	10.2697835	30
		Sine.		Tang		Secant	M

57 Degrees.

32 Degrees.

M	Sine.		Tang		Secant		
30	9.7302165	9.9260292	9.8041873	10.1958127	10.0739708	10.2697835	30
31	9.7304148	9.9259487	9.8044661	10.1955339	10.0740513	10.2695852	29
32	9.7306129	9.9258681	9.8047447	10.1952553	10.0741319	10.2693871	28
33	9.7308109	9.9257875	9.8050233	10.1949767	10.0742125	10.2691891	27
34	9.7310087	9.9257069	9.8053019	10.1946981	10.0742931	10.2689913	26
35	9.7312064	9.9256261	9.8055803	10.1944197	10.0743739	10.2687936	25
36	9.7314040	9.9255454	9.8058587	10.1941413	10.0744546	10.2685960	24
37	9.7316015	9.9254646	9.8061370	10.1938630	10.0745354	10.2683985	23
38	9.7317989	9.9253837	9.8064152	10.1935848	10.0746163	10.2682011	22
39	9.7319961	9.9253028	9.8066933	10.1933067	10 0746972	10.2680039	21
40	9.7321932	9.9252218	9.8069714	10.1930286	10 0747782	10.2678068	20
41	9.7323902	9.9251408	9.8072494	10.1927506	10.0748592	10.2676098	19
42	9.7325870	9.9250597	9.8075273	10.1924727	10 0749403	10.2674130	18
43	9.7327837	9.9249786	9.8078052	10.1921948	10.0750214	10 2672163	17
44	9.7329803	9.9248974	9.8080829	10.1919171	10.0751026	10.2670197	16
45	9.7331768	9.9248161	9.8083606	10.1916394	10.0751839	10.2668232	15
46	9.7333731	9.9247349	9.8086383	10.1913617	10.0752651	10.2666269	14
47	9.7335693	9.9246535	9.8089158	10.1910842	10.0753465	10.2664307	13
48	9.7337654	9.9245721	9.8091933	10.1908067	10.0754279	10.2662346	12
49	9.7339614	9.9244907	9.8094707	10.1905293	10.0755093	10.2660386	11
50	9.7341572	9.9244092	9.8097480	10.1902520	10.0755908	10.2658428	10
51	9.7343529	9.9243277	9.8100253	10.1899747	10.0756723	10.2656471	9
52	9.7345485	9.9242461	9.8103025	10.1896975	10.0757539	10.2654515	8
53	9.7347440	9.9241644	9.8105796	10.1894204	10.0758356	10.2652560	7
54	9.7349393	9.9240827	9.8108566	10.1891434	10.0759173	10.2650607	6
55	9.7351345	9.9240110	9.8111336	10.1888664	10.0759990	10.2648655	5
56	9.7353296	9.9239191	9.8114105	10.1885895	10.0760809	10.2646704	4
57	9.7355246	9.9238373	9.8116873	10.1883127	10.0761627	10.2644754	3
58	9.7357195	9.9237554	9.8119641	10.1880359	10.0762446	10.2642805	2
59	9.7359142	9.9236734	9.8122408	10.1877592	10.0763266	10.2640858	1
60	9.7361088	9 9235914	9.8125174	10.1874826	10.0764086	10.2638912	0
		Sine.		Tang		Secant	M

57 Degrees.

A Table of Artificial Sines,

33 Degrees.

M	Sine		Tang		Secant		M
0	9.7361088	9.9235914	9.8125174	10.1874826	10.0764086	10.2638912	60
1	9.7363032	9.9235093	9.8127939	10.1872061	10.0764907	10.2636968	59
2	9.7364976	9.9234272	9.8130704	10.1869296	10.0765728	10.2635024	58
3	9.7366918	9.9233450	9.8133468	10.1866532	10.0766550	10.2633082	57
4	9.7368859	9.9232628	9.8136231	10.1863769	10.0767372	10.2631141	56
5	9.7370799	9.9231805	9.8138993	10.1861007	10.0768195	10.2629201	55
6	9.7372737	9.9230982	9.8141755	10.1858243	10.0769018	10.2627263	54
7	9.7374675	9.9230158	9.8144516	10.1855484	10.0769842	10.2625325	53
8	9.7376611	9.9229334	9.8147277	10.1852723	10.0770666	10.2623389	52
9	9.7378546	9.9228509	9.8150036	10.1849964	10.0771491	10.2621454	51
10	9.7380479	9.9227684	9.8152795	10.1847205	10.0772316	10.2619521	50
11	9.7382412	9.9226858	9.8155554	10.1844446	10.0773142	10.2617588	49
12	9.7384343	9.9226032	9.8158311	10.1841689	10.0773969	10.2615657	48
13	9.7386273	9.9225205	9.8161068	10.1838932	10.0774795	10.2613727	47
14	9.7388201	9.9224377	9.8163824	10.1836176	10.0775623	10.2611799	46
15	9.7390129	9.9223549	9.8166580	10.1833420	10.0776451	10.2609871	45
16	9.7392055	9.9222721	9.8169335	10.1830665	10.0777279	10.2607945	44
17	9.7393980	9.9221891	9.8172089	10.1827911	10.0778109	10.2606020	43
18	9.7395904	9.9221062	9.8174842	10.1825158	10.0778938	10.2604096	42
19	9.7397827	9.9220232	9.8177595	10.1822405	10.0779768	10.2602173	41
20	9.7399748	9.9219401	9.8180347	10.1819653	10.0780599	10.2600252	40
21	9.7401668	9.9218570	9.8183098	10.1816902	10.0781430	10.2598332	39
22	9.7403587	9.9217738	9.8185849	10.1814151	10.0782262	10.2596413	38
23	9.7405705	9.9216906	9.8188599	10.1811401	10.0783094	10.2594495	37
24	9.7407421	9.9216073	9.8191348	10.1808652	10.0783927	10.2592579	36
25	9.7409337	9.9215240	9.8194096	10.1805904	10.0784760	10.2590663	35
26	9.7411251	9.9214406	9.8196844	10.1803156	10.0785594	10.2588749	34
27	9.7413164	9.9213572	9.8199592	10.1800408	10.0786428	10.2586836	33
28	9.7415075	9.9212737	9.8202338	10.1797662	10.0787263	10.2584925	32
29	9.7416986	9.9211902	9.8205084	10.1794916	10.0788098	10.2583014	31
30	9.7418895	9.9211066	9.8207829	10.1792171	10.0788934	10.2581105	30
		Sine.		Tang		Secant	M

56 Degrees.

Tangents, and Secants.

33 Degrees.

M	Sine.		Tang		Secant		
30	9.7418895	9.9211066	9.8207829	10.1792171	10.0788934	10.2581105	30
31	9.7420803	9.9210229	9.8210574	10.1789426	10.0789771	10.2579197	29
32	9.7422710	9.9209393	9.8213317	10.1786683	10.0790607	10.2577290	28
33	9.7424616	9.9208555	9.8216060	10.1783940	10.0791445	10.2575384	27
34	9.7426520	9.9207717	9.8218803	10.1781197	10.0792283	10.2573480	26
35	9.7428423	9.9206878	9.8221545	10.1778455	10.0793122	10.2571577	25
36	9.7430325	9.9206039	9.8224286	10.1775714	10.0793961	10.2569675	24
37	9.7432220	9.9205200	9.8227026	10.1772974	10.0794800	10.2567774	23
38	9.7434126	9.9204360	9.8229766	10.1770234	10.0795640	10.2565874	22
39	9.7436024	9.9203519	9.8232505	10.1767495	10.0796481	10.2563976	21
40	9.7437921	9.9202678	9.8235244	10.1764756	10.0797322	10.2562079	20
41	9.7439817	9.9201863	9.8237981	10.1762019	10.0798164	10.2560183	19
42	9.7441712	9.9200994	9.8240719	10.1759281	10.0799006	10.2558288	18
43	9.7443606	9.9200151	9.8243455	10.1756545	10.0799849	10.2556394	17
44	9.7445498	9.9199308	9.8246191	10.1753809	10.0800692	10.2554502	16
45	9.7447390	9.9198464	9.8248926	10.1751074	10.0801536	10.2552610	15
46	9.7449280	9.9197619	9.8251660	10.1748340	10.0802381	10.2550720	14
47	9.7451169	9.9196775	9.8254394	10.1745606	10.0803225	10.2548831	13
48	9.7453056	9.9195929	9.8257127	10.1742873	10.0804071	10.2546944	12
49	9.7454943	9.9195083	9.8259860	10.1740140	10.0804917	10.2545057	11
50	9.7456828	9.9194237	9.8262592	10.1737408	10.0805763	10.2543172	10
51	9.7458712	9.9193390	9.8265323	10.1734677	10.0806610	10.2541288	9
52	9.7460595	9.9192542	9.8268053	10.1731947	10.0807458	10.2539405	8
53	9.7462477	9.9191694	9.8270783	10.1729217	10.0808306	10.2537523	7
54	9.7464358	9.9190845	9.8273513	10.1726487	10.0809155	10.2535642	6
55	9.7466237	9.9189996	9.8276241	10.1723759	10.0810004	10.2533763	5
56	9.7468115	9.9189146	9.8278969	10.1721031	10.0810854	10.2531885	4
57	9.7469992	9.9188296	9.8281696	10.1718304	10.0811704	10.2530008	3
58	9.7471868	9.9187445	9.8284423	10.1715577	10.0812555	10.2528132	2
59	9.7473743	9.9186594	9.8287149	10.1712851	10.0813406	10.2526257	1
60	9.7475617	9.9185742	9.8289874	10.1710126	10.0814258	10.2524383	0
		Sine.		Tang		Secant	M

56 Degrees.

A Table of Artificial Sines,

34 *Degrees.*

M	Sine.		Tang		Secant		
0	9.7475617	9.9185742	9.8289874	10.1710126	10.0814258	10.2524383	60
1	9.7477489	9.9184890	9.8292599	10.1707401	10.0815110	10.2522511	59
2	9.7479360	9.9184037	9.8295323	10.1704677	10.0815963	10.2520640	58
3	9.7481230	9.9183183	9.8298047	10.1701953	10.0816817	10.2518770	57
4	9.7483099	9.9182329	9.8300769	10.1699231	10.0817671	10.2516901	56
5	9.7484967	9.9181475	9.8303492	10.1696508	10.0818525	10.2515033	55
6	9.7486833	9.9180620	9.8306213	10.1693787	10.0819380	10.2513167	54
7	9.7488698	9.9179764	9.8308934	10.1691066	10.0820236	10.2511302	53
8	9.7490562	9.9178908	9.8311654	10.1688346	10.0821092	10.2509438	52
9	9.7492425	9.9178051	9.8314374	10.1685626	10.0821949	10.2507575	51
10	9.7494287	9.9177194	9.8317093	10.1682907	10.0822806	10.2505713	50
11	9.7496148	9.9176336	9.8319811	10.1680189	10.0823664	10.2503852	49
12	9.7498007	9.9175478	9.8322529	10.1677471	10.0824522	10.2501993	48
13	9.7499866	9.9174619	9.8325246	10.1674754	10.0825381	10.2500134	47
14	9.7501723	9.9173760	9.8327963	10.1672037	10.0826240	10.2498277	46
15	9.7503579	9.9172900	9.8330679	10.1669321	10.0827100	10.2496421	45
16	9.7505434	9.9172040	9.8333394	10.1666606	10.0827960	10.2494566	44
17	9.7507287	9.9171179	9.8336109	10.1663891	10.0828821	10.2492713	43
18	9.7509140	9.9170317	9.8338823	10.1661177	10.0829683	10.2490860	42
19	9.7510991	9.9169455	9.8341536	10.1658464	10.0830545	10.2489009	41
20	9.7512842	9.9168593	9.8344249	10.1655751	10.0831407	10.2487158	40
21	9.7514691	9.9167730	9.8346961	10.1653039	10.0832270	10.2485309	39
22	9.7516538	9.9166866	9.8349673	10.1650327	10.0833134	10.2483462	38
23	9.7518385	9.9166002	9.8352384	10.1647616	10.0833998	10.2481615	37
24	9.7520231	9.9165137	9.8355094	10.1644906	10.0834863	10.2479769	36
25	9.7522075	9.9164272	9.8357804	10.1642196	10.0835728	10.2477925	35
26	9.7523919	9.9163406	9.8360513	10.1639487	10.0836594	10.2476081	34
27	9.7525761	9.9162539	9.8363221	10.1636779	10.0837461	10.2474239	33
28	9.7527602	9.9161673	9.8365929	10.1634071	10.0838327	10.2472398	32
29	9.7529442	9.9160805	9.8368636	10.1631364	10.0839195	10.2470558	31
30	9.7531280	9.9169937	9.8371342	10.1628657	10.0840063	10.2468720	30
		Sine.		Tang		Secant	M

55 *Degrees.*

34 Degrees.

M	Sine		Tang		Secant		
30	9.7531280	9.9159937	9.8371343	10.1628657	10.0840063	10.2468720	30
31	9.7533118	9.9159069	9.8374049	10.1625951	10.0840931	10.2466882	29
32	9.7534954	9.9158200	9.8376755	10.1623245	10.0841800	10.2465046	28
33	9.7536790	9.9157330	9.8379460	10.1620540	10.0842670	10.2463210	27
34	9.7538624	9.9156460	9.8382164	10.1617836	10.0843540	10.2461376	26
35	9.7540457	9.9155589	9.8384867	10.1615133	10.0844412	10.2459543	25
36	9.7542288	9.9154718	9.8387571	10.1612429	10.0845282	10.2457712	24
37	9.7544119	9.9153846	9.8390273	10.1609727	10.0846154	10.2455881	23
38	9.7545949	9.9152974	9.8392975	10.1607025	10.0847026	10.2454051	22
39	9.7547777	9.9152101	9.8395676	10.1604324	10.0847899	10.2452223	21
40	9.7549604	9.9151228	9.8398377	10.1601623	10.0848772	10.2450396	20
41	9.7551431	9.9150354	9.8401077	10.1598923	10.0849646	10.2448569	19
42	9.7553256	9.9149479	9.8403776	10.1596224	10.0850521	10.2446744	18
43	9.7555080	9.9148604	9.8406475	10.1593525	10.0851396	10.2444920	17
44	9.7556902	9.9147729	9.8409174	10.1590826	10.0852271	10.2443098	16
45	9.7558724	9.9146852	9.8411871	10.1588129	10.0853148	10.2441276	15
46	9.7560544	9.9145976	9.8414569	10.1585431	10.0854024	10.2439456	14
47	9.7562364	9.9145099	9.8417265	10.1582735	10.0854901	10.2437636	13
48	9.7564182	9.9144221	9.8419961	10.1580039	10.0855779	10.2435818	12
49	9.7565999	9.9143342	9.8422657	10.1577343	10.0856658	10.2434001	11
50	9.7567815	9.9142464	9.8425351	10.1574649	10.0857536	10.2432185	10
51	9.7569630	9.9141584	9.8428046	10.1571954	10.0858416	10.2430370	9
52	9.7571444	9.9140704	9.8430739	10.1569261	10.0859296	10.2428556	8
53	9.7573256	9.9139824	9.8433432	10.1566568	10.0860176	10.2426744	7
54	9.7575068	9.9138943	9.8436125	10.1563876	10.0861057	10.2424932	6
55	9.7576878	9.9138061	9.8438817	10.1561183	10.0861939	10.2423122	5
56	9.7578687	9.9137179	9.8441508	10.1558492	10.0862821	10.2421313	4
57	9.7580495	9.9136296	9.8444199	10.1555801	10.0863704	10.2419505	3
58	9.7582302	9.9135413	9.8446889	10.1553111	10.0864587	10.2417698	2
59	9.7584108	9.9134530	9.8449579	10.1550421	10.0865471	10.2415892	1
60	9.7585913	9.9133645	9.8452268	10.1547732	10.0866355	10.2414087	0
		Sine.		Tang		Secant	M

55 Degrees.

A Table of Artificial Sines,

35 *Degrees.*

M	Sine.		Tang		Secant		
0	9 7585913	9.9133645	9.8452268	10.1547732	10.0866355	10.2414087	60
1	9.7587717	9.9132760	9.8454956	10.1545044	10.0867240	10.2412283	59
2	9.7589519	9 9131875	9.8457644	10.1542356	10.0868125	10.2410481	58
3	9.7591321	9.9130989	9.8460332	10.1539668	10.0869011	10.2408679	57
4	9.7593121	9.9130102	9.8463018	10.1536982	10.0869898	10.2406879	56
5	9.7594920	9.9129215	9.8465705	10.1534295	10.0870785	10.2405080	55
6	9.7596718	9.9128328	9.8468390	10.1531610	10.0871672	10.2403282	54
7	9.7598515	9 9127440	9.8471075	10.1528925	10.0872560	10.2401485	53
8	9.7600311	9.9126551	9.8473760	10.1526240	10.0873449	10.2399689	52
9	9.7602106	9.9125662	9.8476444	10.1523556	10.0874338	10.2397894	51
10	9.7603899	9.9124772	9.8479127	10.1520873	10.0875228	10.2396101	50
11	9.7605692	9.9123882	9.8481810	10.1518190	10.0876118	10.2394308	49
12	9.7607483	9.9122991	9.8484492	10.1515508	10.0877009	10.2392517	48
13	9.7609274	9.9122099	9.8487174	10.1512826	10.0877901	10.2390726	47
14	9.7611063	9.9121207	9.8489855	10.1510145	10.0878793	10.2388937	46
15	9.7612851	9.9120315	9.8492536	10.1507464	10.0879685	10.2387149	45
16	9.7614638	9.9119422	9.8495216	10.1504784	10.0880578	10.2385362	44
17	9.7616424	9.9118528	9.8497896	10.1502104	10.0881472	10.2383576	43
18	9.7618208	9.9117634	9.8500575	10.1499425	10.0882366	10.2381792	42
19	9.7619992	9.9116739	9.8503253	10.1496747	10.0883261	10.2380008	41
20	9.7621775	9.9115844	9.8505931	10.1494069	10.0884156	10.2378225	40
21	9.7623556	9.9114948	9.8508608	10.1491392	10.0885052	10.2376444	39
22	9.7625337	9.9114051	9.8511285	10.1488715	10.0885949	10.2374663	38
23	9.7627116	9.9113155	9.8513961	10.1486039	10.0886845	10.2372884	37
24	9.7628894	9.9112257	9.8516637	10.1483363	10.0887743	10.2371106	36
25	9.7630671	9.9111359	9.8519312	10.1480688	10.0888641	10.2369329	35
26	9.7632447	9.9110460	9.8521987	10.1478013	10.0889540	10.2367553	34
27	9.7634222	9.9109561	9.8524661	10.1475339	10.0890439	10.2365778	33
28	9.7635996	9.9108661	9.8527335	10.1472665	10.0891339	10.2364004	32
29	9.7637769	9.9107761	9.8530008	10.1469992	10.0892239	10.2362231	31
30	9.7639540	9.9106860	9.8532680	10.1467320	10.0893140	10.2360460	30
		Sine.		Tang		Secant	M

54 *Degrees.*

35 Degrees.

M	Sine.		Tang		Secant		
30	9.7639540	9.9106860	9.8532680	10.1467320	10.0893140	10.2360460	30
31	9.7641311	9.9105959	9.8535352	10.1464648	10.0894041	10.2358689	29
32	9.7643080	9.9105057	9.8538023	10.1461977	10.0894943	10.2356920	28
33	9.7644849	9.9104155	9.8540694	10.1459306	10.0895846	10.2355151	27
34	9.7646616	9.9103251	9.8543365	10.1456635	10.0896749	10.2353384	26
35	9.7648382	9.9102348	9.8546034	10.1453966	10.0897652	10.2351618	25
36	9.7650147	9.9101444	9.8548704	10.1451296	10.0898556	10.2349853	24
37	9.7651911	9.9100539	9.8551372	10.1448628	10.0899461	10.2348089	23
38	9.7653674	9.9099633	9.8554041	10.1445959	10.0900366	10.2346326	22
39	9.7655436	9.9098728	9.8556708	10.1443292	10.0901272	10.2344564	21
40	9.7657197	9.9097821	9.8559376	10.1440624	10.0902179	10.2342803	20
41	9.7658957	9.9096915	9.8562042	10.1437958	10.0903085	10.2341043	19
42	9.7660715	9.9096007	9.8564708	10.1435292	10.0903993	10.2339285	18
43	9.7662473	9.9095099	9.8567374	10.1432626	10.0904901	10.2337527	17
44	9.7664229	9.9094190	9.8570039	10.1429961	10.0905810	10.2335771	16
45	9.7665985	9.9093281	9.8572704	10.1427296	10.0906719	10.2334015	15
46	9.7667739	9.9092371	9.8575368	10.1424632	10.0907629	10.2332261	14
47	9.7669492	9.9091461	9.8578031	10.1421969	10.0908539	10.2330508	13
48	9.7671244	9.9090550	9.8580694	10.1419306	10.0909450	10.2328756	12
49	9.7672996	9.9089639	9.8583357	10.1416643	10.0910361	10.2327004	11
50	9.7674746	9.9088727	9.8586019	10.1413981	10.0911273	10.2325254	10
51	9.7676494	9.9087814	9.8588680	10.1411320	10.0912186	10.2323506	9
52	9.7678242	9.9086901	9.8591341	10.1408659	10.0913099	10.2321758	8
53	9.7679989	9.9085988	9.8594002	10.1405998	10.0914012	10.2320011	7
54	9.7681735	9.9085073	9.8596661	10.1403339	10.0914927	10.2318265	6
55	9.7683480	9.9084159	9.8599321	10.1400679	10.0915841	10.2316520	5
56	9.7685223	9.9083243	9.8601980	10.1398020	10.0916757	10.2314777	4
57	9.7686966	9.9082327	9.8604638	10.1395362	10.0917673	10.2313034	3
58	9.7688707	9.9081411	9.8607296	10.1392704	10.0918589	10.2311293	2
59	9.7690448	9.9080494	9.8609954	10.1390046	10.0919506	10.2309553	1
60	9.7692187	9.9079576	9.8612610	10.1387390	10.0920424	10.2307813	0
		Sine.		Tang.		Secant	M

54 Degrees.

A Table of Artificial Sines,

36 Degrees.

M	Sine.		Tang		Secant		
0	9.7692187	9.9079576	9.8612610	10.1387390	10.0920424	10 2307813	60
1	9.7693925	9.9078658	9.8615267	10.1384733	10.0921342	10.2306075	59
2	9.7695662	9.9077740	9.8617923	10.1382077	10.0922260	10.2304338	58
3	9.7697398	9.9076820	9.8620578	10.1379422	10.0923180	10.2302602	57
4	9.7699134	9.9075901	9.8623233	10.1376767	10.0924099	10.2300866	56
5	9.7700868	9.9074980	9.8625887	10.1374113	10.0925020	10.2299132	55
6	9.7702601	9.9074059	9.8628541	10.1371459	10.0925941	10.2297399	54
7	9.7704333	9.9073138	9.8631195	10.1368805	10.0926862	10.2295668	53
8	9.7706063	9.9072216	9.8633848	10.1366152	10.0927784	10.2293937	52
9	9.7707793	9.9071293	9.8636500	10.1363500	10.0928707	10.2292207	51
10	9.7709522	9.9070370	9.8639152	10.1360848	10.0929630	10.2290478	50
11	9.7711249	9.9069446	9.8641803	10.1358197	10.0930554	10.2288751	49
12	9.7712976	9.9068522	9.8644454	10.1355546	10.0931478	10.2287024	48
13	9.7714702	9.9067597	9.8647105	10.1352895	10.0932403	10.2285298	47
14	9.7716426	9.9066671	9.8649755	10.1350245	10.0933329	10.2283574	46
15	9.7718150	9.9065745	9.8652404	10.1347596	10.0934255	10.2281850	45
16	9.7719872	9.9064819	9.8655053	10.1344947	10.0935181	10.2280128	44
17	9.7721593	9.9053892	9.8657702	10.1342298	10.0936108	10.2278407	43
18	9.7723314	9.9062964	9.8660350	10.1339650	10.0937036	10.2276686	42
19	9.7725033	9.9062036	9.8662997	10.1337003	10.0937964	10.2274967	41
20	9.7726751	9.9061107	9.8665644	10.1334356	10.0938893	10.2273249	40
21	9.7728468	9.9060177	9.8668291	10.1331709	10.0939823	10.2271532	39
22	9.7730185	9.9059247	9.8670937	10.1329063	10.0940753	10.2269815	38
23	9.7731900	9.9058317	9.8673583	10.1326417	10.0941683	10.2268100	37
24	9.7733614	9.9057386	9.8676228	10.1323772	10.0942614	10.2266386	36
25	9.7735327	9.9056454	9.8678873	10.1321127	10.0943546	10.2264673	35
26	9.7737039	9.9055522	9.8681517	10.1318483	10.0944478	10.2262961	34
27	9.7738749	9.9054589	9.8684160	10.1315840	10.0945411	10.2261251	33
28	9.7740459	9.9053656	9.8686804	10.1313196	10.0946344	10.2259541	32
29	9.7742168	9.9052722	9.8689446	10.1310554	10.0947278	10.2257832	31
30	9.7743876	9.9051787	9.8692089	10.1307911	10.0948213	10.2256124	30
		Sine.		Tang		Secant	M

53 Degrees.

36 Degrees.

M	Sine.		Tang		Secant		
30	9.7743876	9.9051787	9.8692089	10.1307911	10.0948213	10.2256124	30
31	9.7745583	9.9050852	9.8694731	10.1305269	10.0949148	10.2254417	29
32	9.7747288	9.9049916	9.8697372	10.1302628	10.0950084	10.2252712	28
33	9.7748993	9.9048980	9.8700013	10.1299987	10.0951020	10.2251007	27
34	9.7750697	9.9048043	9.8702653	10.1297347	10.0951957	10.2249303	26
35	9.7752399	9.9047106	9.8705293	10.1294707	10.0952894	10.2247601	25
36	9.7754101	9.9046168	9.8707933	10.1292067	10.0953832	10.2245899	24
37	9.7755801	9.9045230	9.8710572	10.1289428	10.0954770	10.2244199	23
38	9.7757501	9.9044291	9.8713210	10.1286790	10.0955709	10.2242499	22
39	9.7759199	9.9043351	9.8715848	10.1284152	10.0956649	10.2240801	21
40	9.7760897	9.9042411	9.8718486	10.1281514	10.0957589	10.2239103	20
41	9.7762593	9.9041470	9.8721123	10.1278877	10.0958530	10.2237407	19
42	9.7764289	9.9040529	9.8723760	10.1276240	10.0959471	10.2235711	18
43	9.7765983	9.9039587	9.8726396	10.1273604	10.0960413	10.2234017	17
44	9.7767676	9.9038644	9.8729032	10.1270968	10.0961356	10.2232324	16
45	9.7769369	9.9037701	9.8731668	10.1268332	10.0962299	10.2230631	15
46	9.7771060	9.9036757	9.8734302	10.1265698	10.0963243	10.2228940	14
47	9.7772750	9.9035813	9.8736937	10.1263063	10.0964187	10.2227250	13
48	9.7774439	9.9034868	9.8739571	10.1260420	10.0965132	10.2225561	12
49	9.7776128	9.9033923	9.8742104	10.1257796	10.0966077	10.2223872	11
50	9.7777815	9.9032977	9.8744838	10.1255162	10.0967023	10.2222185	10
51	9.7779501	9.9032031	9.8747470	10.1252530	10.0967969	10.2220499	9
52	9.7781186	9.9031084	9.8750102	10.1249898	10.0968916	10.2218814	8
53	9.7782870	9.9030136	9.8752734	10.1247266	10.0969864	10.2217130	7
54	9.7784553	9.9029188	9.8755365	10.1244635	10.0970812	10.2215447	6
55	9.7786235	9.9028239	9.8757996	10.1242004	10.0971761	10.2213756	5
56	9.7787916	9.9027289	9.8760627	10.1239373	10.0972711	10.2212084	4
57	9.7789596	9.9026339	9.8763257	10.1236743	10.0973661	10.2210404	3
58	9.7791275	9.9025389	9.8765886	10.1234114	10.0974611	10.2208725	2
59	9.7792953	9.9024438	9.8768515	10.1231485	10.0975562	10.2207047	1
60	9.7794630	9.9023486	9.8771144	10.1228856	10.0976514	10.2205370	0
		Sine.		Tang		Secant	M

53 Degrees.

A Table of Artificial Sines,

37 Degrees.

M	Sine		Tang		Secant		
0	9.7794630	9.9023486	9.8771144	10.1228856	10.0976514	10 2205370	60
1	9.7796306	9.9022534	9.8773772	10.1226228	10.0977466	10.2203694	59
2	9.7797981	9.9021581	9.8776400	10.1223600	10.0978419	10.2202019	58
3	9.7799655	9.9020628	9.8779027	10.1220973	10.0979372	10.2200345	57
4	9.7801328	9.9019674	9.8781654	10.1218346	10.0980326	10.2198672	56
5	9.7803000	9.9018719	9.8784281	10.1215719	10.0981281	10.2197000	55
6	9.7804671	9.9017764	9.8786907	10.1213093	10.0982236	10.2195329	54
7	9.7806341	9.9016808	9.8789533	10.1210467	10.0983192	10.2193659	53
8	9.7808010	9.9015852	9.8792158	10.1207842	10.0984148	10.2191990	52
9	9.7809677	9.9014895	9.8794782	10.1205218	10.0985105	10.2190323	51
10	9.7811344	9.9013938	9.8797407	10.1202593	10.0986062	10.2188656	50
11	9.7813010	9.9012980	9.8800031	10.1199969	10.0987020	10.2186990	49
12	9.7814675	9.9012021	9.8802654	10.1197346	10.0987979	10.2185325	48
13	9.7816339	9.9011062	9.8805277	10.1194723	10.0988938	10.2183661	47
14	9.7818002	9.9010102	9.8807900	10.1192100	10.0989898	10.2181998	46
15	9.7819664	9.9009142	9.8810522	10.1189478	10.0990858	10.2180336	45
16	9.7821324	9.9008181	9.8813144	10.1186856	10.0991819	10.2178676	44
17	9.7822984	9.9007219	9.8815765	10.1184235	10.0992781	10.2177016	43
18	9.7824643	9.9006257	9.8818386	10.1181614	10.0993743	10.2175357	42
19	9.7826301	9.9005294	9.8821007	10.1178993	10.0994708	10.2173699	41
20	9.7827958	9.9004331	9.8823627	10.1176374	10.0995669	10.2172042	40
21	9.7829614	9.9003367	9.8826246	10.1173754	10.0996633	10.2170386	39
22	9.7831268	9.9002403	9.8828866	10.1171134	10.0997597	10.2168732	38
23	9.7832922	9.9001438	9.8831484	10.1168516	10.0998562	10.2167078	37
24	9.7834575	9.9000472	9.8834103	10.1165897	10.0999528	10.2165425	36
25	9.7836227	9.8999506	9.8836721	10.1163279	10.1000494	10.2163773	35
26	9.7837878	9.8998539	9.8839338	10.1160662	10.1001461	10.2162122	34
27	9.7839582	9.8997572	9.8841955	10.1158044	10.1002428	10.2160472	33
28	9.7841177	9.8996604	9.8844572	10.1155428	10.1003396	10.2158823	32
29	9.7842824	9.8995636	9.8847189	10.1152811	10.1004364	10.2157176	31
30	9.7844471	9.8994667	9.8849805	10.1150195	10.1005333	10.2155529	30
		Sine.		Tang.		Secant	M

52 Degrees.

37 *Degrees.*

M	Sine		Tang		Secant		
30	9.7844471	9.8994667	9.8849805	10.1150195	10.1005333	10.2155529	30
31	9.7846117	9.8993697	9.8852420	10.1147580	10.1006303	10.2153883	29
32	9.7847762	9.8992727	9.8855035	10.1144965	10.1007273	10.2152238	28
33	9.7849406	9.8991756	9.8857650	10.1142350	10.1008244	10.2150594	27
34	9.7851049	9.8990784	9.8860264	10.1139737	10.1009216	10.2148951	26
35	9.7852691	9.8989812	9.8862878	10.1137122	10.1010188	10.2147309	25
36	9.7854332	9.8988840	9.8865492	10.1134508	10.1011160	10.2145668	24
37	9.7855972	9.8987867	9.8868105	10.1131895	10.1012133	10.2144028	23
38	9.7857611	9.8986893	9.8870718	10.1129282	10.1013107	10.2142389	22
39	9.7859249	9.8985919	9.8873330	10.1126670	10.1014081	10.2140751	21
40	9.7860886	9.8984944	9.8875942	10.1124058	10.1015056	10.2139114	20
41	9.7862522	9.8983968	9.8878554	10.1121446	10.1016032	10.2137478	19
42	9.7864157	9.8982992	9.8881165	10.1118835	10.1017008	10.2135843	18
43	9.7865791	9.8982015	9.8883775	10.1116225	10.1017985	10.2134209	17
44	9.7867424	9.8981038	9.8886386	10.1113614	10.1018962	10.2132576	16
45	9.7869056	9.8980060	9.8888996	10.1111004	10.1019940	10.2130944	15
46	9.7870687	9.8979082	9.8891605	10.1108395	10.1020918	10.2129313	14
47	9.7872317	9.8978103	9.8894214	10.1105786	10.1021897	10.2127683	13
48	9.7873946	9.8977123	9.8896823	10.1103177	10.1022877	10.2126054	12
49	9.7875574	9.8976143	9.8899432	10.1100568	10.1023857	10.2124426	11
50	9.7877202	9.8975162	9.8902040	10.1097060	10.1024838	10.2122798	10
51	9.7878828	9.8974181	9.8904647	10.1095353	10.1025819	10.2121172	9
52	9.7880453	9.8973199	9.8907254	10.1092746	10.1026801	10.2119547	8
53	9.7882077	9.8972216	9.8909861	10.1090139	10.1027784	10.2117923	7
54	9.7883701	9.8971233	9.8912468	10.1087532	10.1028767	10.2116299	6
55	9.7885323	9.8970249	9.8915074	10.1084926	10.1029751	10.2114677	5
56	9.7886944	9.8969265	9.8917679	10.1082321	10.1030735	10.2113056	4
57	9.7888565	9.8968280	9.8920285	10.1079715	10.1031720	10.2111435	3
58	9.7890184	9.8967294	9.8922890	10.1077110	10.1032706	10.2109816	2
59	9.7891802	9.8966308	9.8925494	10.1074506	10.1033692	10.2108198	1
60	9.7893420	9.8965321	9.8928098	10.1071902	10.1034679	10.2106580	0
		Sine.		Tang		Secant	M

52 *Degrees.*

A Table of Artificial Sines,

38 Degrees.

M	Sine.		Tang		Secant		
0	9.7893420	9.8965321	9.8928098	10.1071902	10.1034679	10.2106580	60
1	9.7895036	9.8964334	9.8930702	10.1069298	10.1035666	10.2104964	59
2	9.7896652	9.8963346	9.8933206	10.1066594	10.1036654	10.2103348	58
3	9.7898266	9.8962358	9.8935909	10.1064091	10.1037642	10.2101734	57
4	9.7899880	9.8961369	9.8938511	10.1061489	10.1038631	10.2100120	56
5	9.7901493	9.8960379	9.8941114	10.1058886	10.1039621	10.2098507	55
6	9.7903104	9.8959389	9.8943715	10.1056285	10.1040611	10.2096896	54
7	9.7904715	9.8958398	9.8946317	10.1053683	10.1041602	10.2095285	53
8	9.7906325	9.8957406	9.8948918	10.1051082	10.1042594	10.2093675	52
9	9.7907933	9.8956414	9.8951519	10.1048481	10.1043586	10.2092067	51
10	9.7909541	9.8955422	9.8954119	10.1045881	10.1044578	10.2090459	50
11	9.7911148	9.8954429	9.8956719	10.1043281	10.1045572	10.2088852	49
12	9.7912754	9.8953435	9.8959319	10.1040681	10.1046565	10.2087246	48
13	9.7914359	9.8952440	9.8961918	10.1038082	10.1047560	10.2085641	47
14	9.7915963	9.8951445	9.8964517	10.1035483	10.1048555	10.2084037	46
15	9.7917566	9.8950450	9.8967116	10.1032884	10.1049550	10.2082434	45
16	9.7919168	9.8949453	9.8969714	10.1030286	10.1050547	10.2080832	44
17	9.7920769	9.8948457	9.8972312	10.1027688	10.1051543	10.2079231	43
18	9.7922369	9.8947459	9.8974910	10.1025090	10.1052541	10.2077631	42
19	9.7923968	9.8946461	9.8977507	10.1022493	10.1053539	10.2076032	41
20	9.7925566	9.8945463	9.8980104	10.1019896	10.1054537	10.2074434	40
21	9.7927163	9.8944463	9.8982700	10.1017300	10.1055537	10.2072837	39
22	9.7928760	9.8943464	9.8985296	10.1014704	10.1056536	10.2071240	38
23	9.7930355	9.8942463	9.8987892	10.1012108	10.1057537	10.2069645	37
24	9.7931949	9.8941462	9.8990487	10.1009513	10.1058538	10.2068051	36
25	9.7933543	9.8940461	9.8993082	10.1006918	10.1059539	10.2066457	35
26	9.7935135	9.8939458	9.8995677	10.1004323	10.1060542	10.2064865	34
27	9.7936727	9.8938456	9.8998271	10.1001729	10.1061544	10.2063273	33
28	9.7938317	9.8937452	9.9000865	10.0999135	10.1062548	10.2061683	32
29	9.7939907	9.8936448	9.9003459	10.0996541	10.1063552	10.2060093	31
30	9.7941496	9.8935444	9.9006052	10.0993948	10.1064556	10.2058504	30
		Sine.		Tang		Secant	M

51 Degrees.

38 *Degrees.*

M	Sine.		Tang		Secant		
30	9.7941496	9.8935444	9.9006052	10.0993948	10.1064556	10.2058504	30
31	9.7943083	9.8934439	9.9008645	10.0991355	10.1065561	10.2056917	29
32	9.7944670	9.8933433	9.9011237	10.0988763	10.1066567	10.2055330	28
33	9.7946256	9.8932426	9.9013830	10.0986170	10.1067574	10.2053744	27
34	9.7947841	9.8931419	9.9016422	10.0983578	10.1068581	10.2052159	26
35	9.7949425	9.8930412	9.9019013	10.0980987	10.1069588	10.2050575	25
36	9.7951008	9 8929404	9.9021604	10.0978396	10.1070596	10.2048992	24
37	9 7952590	9.8928395	9.9024195	10.0975805	10.1071605	10.2047410	23
38	9.7954171	9.8927385	9.9026786	10 0973214	10.1072615	10.2045829	22
39	9.7955751	9.8926375	9.9029376	10.0970624	10.1073625	10.2044249	21
40	9.7957330	9.8925365	9.9031966	10.0968034	10.1074635	10.2042670	20
41	9.7958909	9.8924354	9.9034555	10.0965445	10.1075646	10.2041091	19
42	9.7960486	9.8923342	9.9037144	10.0962856	10.1076658	10.2039514	18
43	9.7962962	9.8922329	9.9039733	10.0960267	10.1077671	10.2037638	17
44	9.7963638	9.8921316	9.9042321	10.0957679	10.1078684	10.2036362	16
45	9.7965212	9.8920303	9.9044910	10.0955090	10.1079697	10.2034788	15
46	9.7966786	9.8919289	9.9047497	10 0952503	10.1080711	10.2033214	14
47	9.7968359	9.8918274	9.9050085	10.0949915	10.1081726	10.2031641	13
48	9.7969930	9.8917258	9.9052672	10.0947328	10.1082742	10.2030070	12
49	9.7971501	9.8916242	9 9055259	10.0944741	10.1083758	10.2028499	11
50	9.7973071	9.8915226	9.9057845	10.0942255	10.1084774	10.2026929	10
51	9.7974640	9.8914208	9.9060431	10.0939569	10.1085792	10.2025360	9
52	9.7976208	9.8913191	9.9063017	10.0936983	10.1086809	10.2023792	8
53	9.7977775	9.8912172	9.9065603	10.0934397	10.1087828	10.2022225	7
54	9.7979341	9.8911153	9.9068188	10.0931812	10.1088847	10.2020659	6
55	9.7980906	9 8910133	9.9070773	10.0929227	10.1089867	10.2019094	5
56	9.7982470	9.8909113	9.9073357	10.0926643	10.1090887	10.2017530	4
57	9.7984034	9.8908092	9.9075941	10.0924059	10.1091908	10.2015966	3
58	9.7985596	9.8907071	9.9078525	10.0921475	10.1092929	10.2014404	2
59	9.7987158	9.8906049	9.9081109	10.0918891	10.1093951	10.2012842	1
60	9 7988718	9.8905026	9.9083692	10 0916308	10.1094974	10.2011282	0
		Sine.		Tang		Secant	M

51 *Degrees.*

A Table of Artificial Sines,

39 Degrees.

M	Sine.		Tang		Secant		
0	9.7988718	9.8905026	9.9083692	10.0916308	10.1091974	10.2011282	60
1	9.7990273	9.8904003	9.9086275	10.0913725	10.1095997	10.2009722	59
2	9.7991836	9.8902979	9.9088858	10.0911142	10.1097021	10.2008164	58
3	9.7993394	9.8901954	9.9091440	10.0908560	10.1098046	10.2006606	57
4	9.7994951	9.8900929	9.9094022	10.0905978	10.1099071	10.2005049	56
5	9.7996507	9.8899903	9.9096603	10.0903397	10.1100097	10.2003493	55
6	9.7998062	9.8898877	9.9099185	10.0900815	10.1101123	10.2001938	54
7	9.7999616	9.8897850	9.9101766	10.0898234	10.1102150	10.2000384	53
8	9.8001169	9.8896822	9.9104347	10.0895653	10.1103178	10.1998831	52
9	9.8002721	9.8895794	9.9106927	10.0893073	10.1104206	10.1997279	51
10	9.8004272	9.8894765	9.9109507	10.0890193	10.1105235	10.1995728	50
11	9.8005823	9.8893736	9.9112087	10.0887913	10.1106264	10.1994177	49
12	9.8007372	9.8892706	9.9114666	10.0885334	10.1107294	10.1992628	48
13	9.8008921	9.8891675	9.9117245	10.0882755	10.1108325	10.1991079	47
14	9.8010468	9.8890644	9.9119824	10.0880176	10.1109356	10.1989532	46
15	9.8012015	9.8889612	9.9122403	10.0877597	10.1110388	10.1987985	45
16	9.8013561	9.8888580	9.9124981	10.0874019	10.1111420	10.1986439	44
17	9.8015106	9.8887547	9.9127559	10.0872441	10.1112453	10.1984894	43
18	9.8016649	9.8886513	9.9130137	10.0869863	10.1113487	10.1983351	42
19	9.8018192	9.8885479	9.9132714	10.0867286	10.1114521	10.1981808	41
20	9.8019735	9.8884444	9.9135291	10.0864709	10.1115556	10.1980265	40
21	9.8021276	9.8883408	9.9137868	10.0862132	10.1116592	10.1978724	39
22	9.8022816	9.8882372	9.9140444	10.0859556	10.1117627	10.1977184	38
23	9.8024355	9.8881335	9.9143020	10.0856980	10.1118665	10.1975645	37
24	9.8025894	9.8880298	9.9145596	10.0854404	10.1119702	10.1974106	36
25	9.8027431	9.8879260	9.9148171	10.0851829	10.1120740	10.1972569	35
26	9.8028968	9.8878221	9.9150747	10.0849253	10.1121779	10.1971032	34
27	9.8030504	9.8877182	9.9153322	10.0846678	10.1122818	10.1969496	33
28	9.8032038	9.8876142	9.9155896	10.0844104	10.1123858	10.1967962	32
29	9.8033572	9.8875102	9.9158471	10.0841529	10.1124898	10.1966428	31
30	9.8035105	9.8874061	9.9161045	10.0838955	10.1125939	10.1964895	30
		Sine.		Tang		Secant	M

50 Degrees.

39 Degrees.

M	Sine.		Tang		Secant		
30	9.8035105	9.8874061	9.9161045	10.0838955	10.1125939	10.1964895	30
31	9.8036637	9.8873019	9.9163618	10.0836382	10.1126981	10.1963363	29
32	9.8038168	9.8871977	9.9166192	10.0833808	10.1128023	10.1961832	28
33	9.8039699	9.8870934	9.9168765	10.0831235	10.1129066	10.1960301	27
34	9.8041228	9.8869890	9.9171338	10.0828662	10.1130110	10.1958772	26
35	9.8042757	9.8868846	9.9173911	10.0826089	10.1131154	10.1957243	25
36	9.8044284	9.8867801	9.9176483	10.0823517	10.1132199	10.1955716	24
37	9.8045811	9.8866756	9.9179055	10.0820945	10.1133244	10.1954189	23
38	9.8047336	9.8865710	9.9181627	10.0818373	10.1134290	10.1952664	22
39	9.8048861	9.8864663	9.9184198	10.0815802	10.1135337	10.1951139	21
40	9.8050385	9.8863616	9.9186769	10.0813231	10.1136384	10.1949615	20
41	9.8051908	9.8862568	9.9189340	10.0810660	10.1137432	10.1948092	19
42	9.8053430	9.8861519	9.9191911	10.0808089	10.1138481	10.1946570	18
43	9.8054951	9.8860470	9.9194481	10.0805519	10.1139530	10.1945049	17
44	9.8056472	9.8859420	9.9197051	10.0802949	10.1140580	10.1943528	16
45	9.8057991	9.8858370	9.9199621	10.0800379	10.1141630	10.1942008	15
46	9.8059510	9.8857319	9.9202191	10.0797809	10.1142681	10.1940490	14
47	9.8061027	9.8856267	9.9204760	10.0795240	10.1143733	10.1938973	13
48	9.8062544	9.8855215	9.9207329	10.0792671	10.1144785	10.1937456	12
49	9.8064060	9.8854162	9.9209898	10.0790102	10.1145838	10.1935940	11
50	9.8065575	9.8853109	9.9212466	10.0787534	10.1146891	10.1934425	10
51	9.8067089	9.8852055	9.9215034	10.0784966	10.1147945	10.1932911	9
52	9.8068602	9.8851000	9.9217602	10.0782398	10.1149000	10.1931398	8
53	9.8070114	9.8849945	9.9220170	10.0779830	10.1150055	10.1929886	7
54	9.8071626	9.8848889	9.9222737	10.0777263	10.1151111	10.1928374	6
55	9.8073136	9.8847832	9.9225304	10.0774696	10.1152168	10.1926864	5
56	9.8074646	9.8846775	9.9227871	10.0772129	10.1153225	10.1925354	4
57	9.8076154	9.8845717	9.9230437	10.0769563	10.1154283	10.1923846	3
58	9.8077662	9.8844659	9.9233004	10.0766996	10.1155341	10.1922338	2
59	9.8079169	9.8843599	9.9235570	10.0764430	10.1156401	10.1920831	1
60	9.8080675	9.8842540	9.9238135	10.0761865	10.1157460	10.1919325	0
		Sine.		Tang.		Secant	M

50 Degrees.

40 *Degrees.*

M	Sine.		Tang		Secant		
0	9.8080675	9.8842540	9.9238135	10.0761865	10.1157460	10.1919325	60
1	9.8082180	9.8841479	9.9240701	10.0759299	10.1158521	10.1917820	59
2	9.8083684	9.8840418	9.9243266	10.0756734	10.1159582	10.1916316	58
3	9.8085188	9.8839357	9.9245831	10.0754169	10.1160643	10.1914812	57
4	9.8086690	9.8838294	9.9248396	10.0751604	10.1161706	10.1913310	56
5	9.8088192	9.8837232	9.9250960	10.0749040	10.1162768	10.1911808	55
6	9.8089692	9.8836168	9.9253524	10.0746476	10.1163832	10.1910308	54
7	9.8091192	9.8835104	9.9256088	10.0743912	10.1164896	10.1908808	53
8	9.8092691	9.8834039	9.9258652	10.0741348	10.1165961	10.1907309	52
9	9.8094189	9.8832974	9.9261215	10.0738785	10.1167026	10.1905811	51
10	9.8095686	9.8831908	9.9263778	10.0736222	10.1168092	10.1904314	50
11	9.8097182	9.8830841	9.9266341	10.0733659	10.1169159	10.1902818	49
12	9.8098678	9.8829774	9.9268904	10.0731096	10.1170226	10.1901322	48
13	9.8100172	9.8828706	9.9271466	10.0728534	10.1171294	10.1899828	47
14	9.8101666	9.8827638	9.9274028	10.0725972	10.1172362	10.1898334	46
15	9.8103159	9.8826568	9.9276590	10.0723410	10.1173432	10.1896841	45
16	9.8104650	9.8825499	9.9279152	10.0720848	10.1174501	10.1895350	44
17	9.8106141	9.8824428	9.9281713	10.0718287	10.1175572	10.1893859	43
18	9.8107631	9.8823357	9.9284274	10.0715726	10.1176643	10.1892369	42
19	9.8109121	9.8822285	9.9286835	10.0713165	10.1177715	10.1890879	41
20	9.8110609	9.8821213	9.9289396	10.0710604	10.1178787	10.1889391	40
21	9.8112096	9.8820140	9.9291956	10.0708044	10.1179860	10.1887904	39
22	9.8113583	9.8819067	9.9294516	10.0705484	10.1180933	10.1886417	38
23	9.8115069	9.8817992	9.9297076	10.0702924	10.1182008	10.1884931	37
24	9.8116554	9.8816918	9.9299636	10.0700364	10.1183082	10.1883446	36
25	9.8118038	9.8815842	9.9302195	10.0697805	10.1184158	10.1881962	35
26	9.8119521	9.8814766	9.9304755	10.0695245	10.1185234	10.1880479	34
27	9.8121003	9.8813689	9.9307314	10.0692686	10.1186311	10.1878997	33
28	9.8122484	9.8812612	9.9309872	10.0690128	10.1187388	10.1877516	32
29	9.8123965	9.8811534	9.9312431	10.0687569	10.1188466	10.1876035	31
30	9.8125444	9.8810455	9.9314989	10.0685011	10.1189545	10.1874556	30
		Sine.		Tang.		Secant	M

49 *Degrees.*

40 Degrees.

M	Sine.		Tang		Secant		
30	9.8125444	9.8810455	9.9314989	10.0685011	10.1189545	10.1874556	30
31	9.8126923	9.8809376	9.9317547	10.0682453	10.1190624	10.1873077	29
32	9.8128401	9.8808296	9.9320105	10.0679895	10.1191704	10.1871599	28
33	9.8129878	9.8807215	9.9322662	10.0677338	10.1192785	10.1870122	27
34	9.8131354	9.8806134	9.9325220	10.0674780	10.1193866	10.1868646	26
35	9.8132829	9.8805052	9.9327777	10.0672223	10.1194948	10.1867171	25
36	9.8134303	9.8803970	9.9330334	10.0669666	10.1196030	10.1865697	24
37	9.8135777	9.8802887	9.9332890	10.0667110	10.1197113	10.1864223	23
38	9.8137250	9.8801803	9.9335446	10.0664554	10.1198197	10.1862750	22
39	9.8138721	9.8800719	9.9338003	10.0661997	10.1199281	10.1861279	21
40	9.8140192	9.8799634	9.9340559	10.0659441	10.1200366	10.1859808	20
41	9.8141662	9.8798548	9.9343114	10.0656886	10.1201452	10.1858338	19
42	9.8143131	9.8797462	9.9345670	10.0654330	10 1202538	10.1856869	18
43	9.8144600	9.8796375	9.9348225	10.0651775	10.1203625	10.1855400	17
44	9.8146067	9.8795287	9.9350780	10.0649220	10.1204713	10.1853933	16
45	9.8147534	9.8794199	9.9353335	10.0646665	10.1205801	10.1852466	15
46	9.8148999	9.8793110	9.9355889	10.0644111	10.1206890	10.1851001	14
47	9.8159464	9.8792021	9.9358444	10.0641556	10.1207979	10.1849536	13
48	9.8151928	9.8790930	9.9360998	10.0639002	10.1209070	10.1848072	12
49	9.8153391	9.8789840	9.9363552	10.0636448	10.1210160	10.1846609	11
50	9.8154854	9.8788748	9.9366105	10.0633895	10.1211252	10.1845146	10
51	9.8156315	9.8787656	9.9368659	10.0631341	10.1212344	10.1843685	9
52	9.8157776	9.8786563	9.9371212	10.0628788	10.1213437	10.1842224	8
53	9.8159235	9.8785470	9.9373765	10.0626235	10.1214530	10.1840765	7
54	9.8160694	9.8784376	9.9376318	10.0623682	10.1215624	10.1839306	6
55	9.8162152	9.8783281	9.9378871	10.0621129	10.1216719	10.1837848	5
56	9.8163609	9.8782186	9.9381423	10.0618577	10.1217814	10.1836391	4
57	9.8165066	9.8781090	9.9383975	10.0616025	10.1218910	10.1834934	3
58	9.8166521	9.8779994	9.9386527	10.0613473	10.1220006	10.1833479	2
59	9.8167975	9.8778896	9.9389079	10.0610921	10.1221104	10.1832025	1
60	9.8169429	9 8777799	9.9391631	10.0608369	10.1222201	10.1830571	0
		Sine.		Tang.		Secant	M

49 Degrees.

A Table of Artificial Sines,

41 Degrees.

M	Sine		Tang		Secant		
0	9.8169429	9.8777799	9.9391630	10.0608369	10.1222201	10.1830571	60
1	9.8170882	9.8776700	9.9394182	10.0605818	10.1223300	10.1829118	59
2	9.8172334	9.8775601	9.9396733	10.0603267	10.1224399	10.1827666	58
3	9.8173785	9.8774501	9.9399284	10.0600716	10.1225499	10.1826215	57
4	9.8175235	9.8773401	9.9401835	10.0598165	10.1226599	10.1824765	56
5	9.8176685	9.8772300	9.9404385	10.0595615	10.1227700	10.1823315	55
6	9.8178133	9.8771198	9.9406936	10.0593064	10.1228802	10.1821867	54
7	9.8179581	9.8770096	9.9409486	10.0590514	10.1229904	10.1820419	53
8	9.8181028	9.8768993	9.9412036	10.0587964	10.1231007	10.1818972	52
9	9.8182474	9.8767889	9.9414585	10.0585415	10.1232111	10.1817526	51
10	9.8183919	9.8766785	9.9417135	10.0582865	10.1233215	10.1816081	50
11	9.8185364	9.8765680	9.9419684	10.0580316	10.1234320	10.1814636	49
12	9.8186807	9.8764574	9.9422233	10.0577767	10.1235426	10.1813193	48
13	9.8188250	9.8763468	9.9424782	10.0575218	10.1236532	10.1811750	47
14	9.8189692	9.8762361	9.9427331	10.0572669	10.1237639	10.1810308	46
15	9.8191133	9.8761253	9.9429879	10.0570121	10.1238747	10.1808867	45
16	9.8192573	9.8760145	9.9432428	10.0567572	10.1239855	10.1807427	44
17	9 8194012	9.8759036	9.9434976	10.0565024	10.1240964	10.1805988	43
18	9.8195450	9.8757927	9.9437524	10.0562476	10.1242073	10.1804550	42
19	9.8196888	9.8756816	9.9440072	10.0559928	10.1243184	10.1803112	41
20	9.8198325	9.8755706	9.9442619	10.0557381	10.1244294	10.1801675	40
21	9.8199761	9.8754594	9.9445166	10 0554834	10.1245406	10.1800239	39
22	9.8201196	9.8753482	9.9447714	10.0552286	10.1246518	10.1798804	38
23	9.8202630	9.8752369	9.9450261	10.0549739	10.1247631	10.1797370	37
24	9.8204063	9.8751256	9.9452807	10.0547193	10.1248744	10.1795937	36
25	9.8205496	9.8750142	9.9455354	10.0544646	10.1249858	10.1794504	35
26	9.8206627	9.8749027	9.9457900	10.0542100	10.1250973	10.1793073	34
27	9.8208358	9.8747912	9.9460447	10.0539553	10.1252088	10.1791642	33
28	9.8209788	9.8746795	9.9462993	10.0537007	10.1253205	10.1790212	32
29	9.8211217	9.8745679	9.9465539	10.0534461	10.1254321	10.1788783	31
30	9.8212646	9.8744561	9.9468084	10.0531916	10.1255439	10.1787354	30
		Sine.		Tang.		Secant	M

48 Degrees.

41 *Degrees.*

M	Sine.		Tang		Secant		
30	9.8212646	9.8744561	9.9468048	10.0531916	10.1255439	10.1787354	30
31	9.8214073	9.8743443	9.9470630	10.0529370	10.1256557	10.1785927	29
32	9.8215500	9.8742325	9.9473175	10.0526825	10.1257675	10.1784500	28
33	9.8216926	9.8741205	9.9475720	10.0524280	10.1258795	10.1783074	27
34	9.8218351	9.8740085	9.9478265	10.0521735	10.1259915	10.1781649	26
35	9.8219775	9.8738965	9.9480810	10.0519190	10.1261035	10.1780225	25
36	9.8221198	9.8737844	9.9483355	10.0516645	10.1262156	10.1778802	24
37	9.8222621	9.8736722	9.9485899	10.0514101	10.1263278	10.1777379	23
38	9.8224042	9.8735599	9.9488443	10.0511557	10.1264401	10.1775958	22
39	9.8225463	9.8734476	9.9490987	10.0509013	10.1265524	10.1774537	21
40	9.8226883	9.8733352	9.9493531	10.0506469	10.1266648	10.1773117	20
41	9.8228302	9.8732227	9.9496075	10.0503925	10.1267773	10.1771698	19
42	9.8229721	9.8731102	9.9498619	10.0501381	10.1268898	10.1770279	18
43	9.8231138	9.8729976	9.9501162	10.0498838	10.1270024	10.1776862	17
44	9.8232355	9.8728849	9.9503705	10.0496295	10.1271151	10.1767445	16
45	9.8233971	9.8727722	9.9506248	10.0493752	10.1272278	10.1766025	15
46	9.8235386	9.8726594	9.9508791	10.0491209	10.1273406	10.1764614	14
47	9.8236800	9.8725466	9.9511334	10.0488666	10.1274534	10.1763200	13
48	9.8238213	9.8724337	9.9513876	10.0486124	10.1275663	10.1761787	12
49	9.8239626	9.8723207	9.9516419	10.0483581	10.1276793	10.1760374	11
50	9.8241037	9.8722076	9.9518961	10.0481039	10.1277924	10.1758963	10
51	9.8242448	9.8720945	9.9521503	10.0478497	10.1279055	10.1757552	9
52	9.8243858	9.8719813	9.9524045	10.0475955	10.1280187	10.1756142	8
53	9.8245267	9.8718681	9.9526587	10.0473413	10.1281319	10.1754733	7
54	9.8246676	9.8717548	9.9529128	10.0470872	10.1282452	10.1753324	6
55	9.8248083	9.8716414	9.9531670	10.0468330	10.1283586	10.1751917	5
56	9.8249490	9.8715279	9.9534211	10.0465789	10.1284721	10.1750510	4
57	9.8250896	9.8714144	9.9536752	10.0463248	10.1285856	10.1749104	3
58	9.8252301	9.8713008	9.9539293	10.0460707	10.1286992	10.1747699	2
59	9.8253705	9.8711872	9.9541834	10.0458166	10.1288128	10.1746295	1
60	9.8255109	9.8710735	9.9544374	10.0455626	10.1289265	10.1744891	0
		Sine.		Tang.		Secant	M

48 *Degrees.*

42 Degrees.

M	Sine.		Tang		Secant		
0	9.8255109	9.8710735	9.9544374	10.0455626	10.1289265	10.1744891	60
1	9.8256512	9.8709597	9.9546915	10.0453085	10.1290403	10.1743488	59
2	9.8257913	9.8708458	9.9549455	10.0450545	10.1291542	10.1742087	58
3	9.8259314	9.8707319	9.9551995	10.0448005	10.1292681	10.1740686	57
4	9.8260715	9.8706179	9.9554535	10.0445465	10.1293821	10.1739285	56
5	9.8262114	9.8705039	9.9557075	10.0442925	10.1294961	10.1737886	55
6	9.8263512	9.8703898	9.9559615	10.0440385	10.1296102	10.1736488	54
7	9.8264910	9.8702756	9.9562154	10.0437846	10.1297244	10.1735090	53
8	9.8266307	9.8701613	9.9564694	10.0435307	10.1298387	10.1733693	52
9	9.8267703	9.8700470	9.9567233	10.0432767	10.1299530	10.1732297	51
10	9.8269098	9.8699326	9.9569772	10.0430228	10.1300674	10.1730902	50
11	9.8270493	9.8698182	9.9572311	10.0427689	10.1301818	10.1729507	49
12	9.8271887	9.8697037	9.9574850	10.0425150	10.1302963	10.1728113	48
13	9.8273279	9.8695891	9.9577389	10.0422611	10.1304109	10.1726721	47
14	9.8274671	9.8694744	9.9579927	10.0420073	10.1305256	10.1725329	46
15	9.8276063	9.8693597	9.9582465	10.0417535	10.1306403	10.1723937	45
16	9.8277453	9.8692449	9.9585004	10.0414996	10.1307551	10.1722547	44
17	9.8278843	9.8691301	9.9587542	10.0412458	10.1308699	10.1721157	43
18	9.8280231	9.8690152	9.9590080	10.0409920	10.1309848	10.1719769	42
19	9.8281619	9.8689002	9.9592618	10.0407382	10.1310998	10.1718381	41
20	9.8283006	9.8687851	9.9595155	10.0404845	10.1312149	10.1716994	40
21	9.8284393	9.8686700	9.9597693	10.0402307	10.1313300	10.1715607	39
22	9.8285778	9.8685548	9.9600230	10.0399770	10.1314452	10.1714222	38
23	9.8287163	9.8684396	9.9602767	10.0397233	10.1315604	10.1712837	37
24	9.8288547	9.8683242	9.9605305	10.0394695	10.1316758	10.1711453	36
25	9.8289930	9.8682088	9.9607842	10.0392158	10.1317912	10.1710070	35
26	9.8291312	9.8680934	9.9610378	10.0389621	10.1319066	10.1708688	34
27	9.8292694	9.8679779	9.9612915	10.0387085	10.1320221	10.1707306	33
28	9.8294075	9.8678623	9.9615542	10.0384548	10.1321377	10.1705925	32
29	9.8295454	9.8677466	9.9617988	10.0382012	10.1322534	10.1704546	31
30	9.8296833	9.8676309	9.9620525	10.0379475	10.1323691	10.1703167	30
		Sine.		Tang		Secant	M

47 Degrees.

42 Degrees.

M	Sine.		Tang		Secant		
30	9.8296833	9.8676309	9.9620525	10.0379475	10.1323691	10.1703167	30
31	9.8298212	9.8675151	9.9623061	10.0376939	10.1324849	10.1701788	29
32	9.8299589	9.8673992	9.9625597	10.0374403	10.1326008	10.1700411	28
33	9.8300966	9.8672833	9.9628133	10.0371867	10.1327167	10.1699034	27
34	9.8302342	9.8671673	9.9630669	10.0369331	10.1328327	10.1697658	26
35	9.8303717	9.8670512	9.9633204	10.0366796	10.1329488	10.1696283	25
36	9.8305091	9.8669351	9.9635740	10.0364260	10.1330649	10.1694909	24
37	9.8306464	9.8668189	9.9638275	10.0361725	10.1331811	10.1693536	23
38	9.8307837	9.8667026	9.9640811	10.0359189	10.1332974	10.1692163	22
39	9.8309209	9.8665863	9.9643346	10.0356654	10.1334137	10.1690791	21
40	9.8310580	9.8664699	9.9645881	10.0354119	10.1335301	10.1689420	20
41	9.8311950	9.8663534	9.9648416	10.0351584	10.1336466	10.1688050	19
42	9.8313320	9.8662369	9.9650951	10.0349049	10.1337631	10.1686680	18
43	9.8314688	9.8661203	9.9653486	10.0346514	10.1338797	10.1685312	17
44	9.8316056	9.8660036	9.9656020	10.0343980	10.1339964	10.1683944	16
45	9.8317423	9.8658868	9.9658555	10.0341445	10.1341132	10.1682577	15
46	9.8318789	9.8657700	9.9661089	10.0338911	10.1342300	10.1681211	14
47	9.8320155	9.8656531	9.9663623	10.0336377	10.1343469	10.1679845	13
48	9.8321519	9.8655362	9.9666157	10.0333843	10.1344638	10.1678481	12
49	9.8322883	9.8654192	9.9668692	10.0331308	10.1345808	10.1677117	11
50	9.8324246	9.8653021	9.9671225	10.0328775	10.1346979	10.1675754	10
51	9.8325609	9.8651849	9.9673759	10.0326241	10.1348151	10.1674391	9
52	9.8326970	9.8650677	9.9676293	10.0323707	10.1349323	10.1673030	8
53	9.8328331	9.8649504	9.9678827	10.0321173	10.1350496	10.1671669	7
54	9.8329691	9.8648331	9.9681360	10.0318640	10.1351669	10.1670309	6
55	9.8331050	9.8647156	9.9683893	10.0316107	10.1352844	10.1668950	5
56	9.8332408	9.8645981	9.9686427	10.0313573	10.1354019	10.1667592	4
57	9.8333766	9.8644806	9.9688960	10.0311040	10.1355194	10.1666234	3
58	9.8335122	9.8643629	9.9691493	10.0308507	10.1356371	10.1664878	2
59	9.8336478	9.8642452	9.9694026	10.0305974	10.1357548	10.1663522	1
60	9.8337833	9.8641275	9.9696559	10.0303441	10.1358725	10.1662167	0
		Sine.		Tang		Secant	M

47 Degrees.

A Table of Artificial Sines,

43 Degrees.

M	Sine.		Tang		Secant		
0	9.8337833	9.8641275	9.9696559	10.0303441	10.1358725	10.1662167	60
1	9.8339188	9.8640096	9.9699091	10.0300909	10.1359904	10.1660812	59
2	9.8340541	9.8638917	9.9701624	10.0298376	10.1361083	10.1659459	58
3	9.8341894	9.8637737	9.9704157	10.0295843	10.1362263	10.1658106	57
4	9.8343246	9.8636557	9.9706689	10.0293311	10.1363443	10.1656754	56
5	9.8344597	9.8635376	9.9709221	10.0290779	10.1364624	10.1655403	55
6	9.8345948	9.8634194	9.9711754	10.0288246	10.1365806	10.1654052	54
7	9.8347297	9.8633011	9.9714286	10.0285714	10.1366989	10.1652703	53
8	9.8348646	9.8631828	9.9716818	10.0283182	10.1368172	10.1651354	52
9	9.8349994	9.8630644	9.9719350	10.0280650	10.1369356	10.1650006	51
10	9.8351341	9.8629460	9.9721882	10.0278118	10.1370540	10.1648659	50
11	9.8352688	9.8628274	9.9724413	10.0275587	10.1371726	10.1647312	49
12	9.8354033	9.8627088	9.9726945	10.0273055	10.1372912	10.1645967	48
13	9.8355378	9.8625902	9.9729477	10.0270523	10.1374098	10.1644622	47
14	9.8356722	9.8624714	9.9732018	10.0267992	10.1375286	10.1643278	46
15	9.8358066	9.8623526	9.9734539	10.0265461	10.1376474	10.1641934	45
16	9.8359408	9.8622338	9.9737071	10.0262929	10.1377662	10.1640592	44
17	9.8360750	9.8621148	9.9739602	10.0260398	10.1378852	10.1639250	43
18	9.8362091	9.8619958	9.9742133	10.0257867	10.1380042	10.1637909	42
19	9.8363431	9.8618767	9.9744664	10.0255336	10.1381233	10.1636569	41
20	9.8364771	9.8617576	9.9747195	10.0252805	10.1382424	10.1635229	40
21	9.8366109	9.8616383	9.9749726	10.0250274	10.1383617	10.1633891	39
22	9.8367447	9.8615190	9.9752257	10.0247743	10.1384810	10.1632553	38
23	9.8368784	9.8613997	9.9754787	10.0245213	10.1386003	10.1631216	37
24	9.8370121	9.8612803	9.9757318	10.0242682	10.1387197	10.1629879	36
25	9.8371456	9.8611608	9.9759849	10.0240251	10.1388392	10.1628544	35
26	9.8372791	9.8610412	9.9762379	10.0237621	10.1389588	10.1627209	34
27	9.8374125	9.8609215	9.9764909	10.0235091	10.1390785	10.1625875	33
28	9.8375458	9.8608018	9.9767440	10.0232560	10.1391982	10.1624542	32
29	9.8376790	9.8606821	9.9769970	10.0230030	10.1393179	10.1623210	31
30	9.8378122	9.8605622	9.9772500	10.0227500	10.1394378	10.1621878	30
		Sine.		Tang		Secant	M

46 Degrees.

43 Degrees.

M	Sine.		Tang		Secant		
30	9.8378122	9.8605622	9.9772500	10.0227500	10.1394378	10.1621878	30
31	9.8379453	9.8604423	9.9775030	10.0224970	10.1395577	10.1620547	29
32	9.8380783	9.8603223	9.9777560	10.0222440	10.1396777	10.1619217	28
33	9.8382112	9.8602022	9.9780090	10.0219910	10.1397978	10.1617888	27
34	9.8383441	9.8600821	9.9782620	10.0217380	10.1399179	10.1616559	26
35	9.8384769	9.8599619	9.9785149	10.0214851	10.1400381	10.1615231	25
36	9.8386066	9.8598416	9.9787679	10.0212321	10.1401584	10.1613904	24
37	9.8387422	9.8597213	9.9790209	10.0209791	10.1402787	10.1612578	23
38	9.8388747	9.8596009	9.9792738	10.0207262	10.1403991	10.1611253	22
39	9.8390072	9.8594804	9.9795268	10.0204732	10.1405196	10.1609928	21
40	9.8391396	9.8593599	9.9797797	10.0202203	10.1406401	10.1608604	20
41	9.8392719	9.8592393	9.9800326	10.0199674	10.1407607	10.1607281	19
42	9.8394041	9.8591186	9.9802856	10.0197144	10.1408814	10.1605959	18
43	9.8395363	9.8589978	9.9805385	10.0194615	10.1410022	10.1604637	17
44	9.8396684	9.8588770	9.9807914	10.0192086	10.1411230	10.1603316	16
45	9.8398004	9.8587561	9.9810443	10.0189557	10.1412439	10.1601996	15
46	9.8399323	9.8586351	9.9812972	10.0187028	10.1413649	10.1600677	14
47	9.8400642	9.8585141	9.9815501	10.0184499	10.1414859	10.1599358	13
48	9.8401959	9.8583929	9.9818030	10.0181970	10.1416071	10.1598041	12
49	9.8403276	9.8582718	9.9820559	10.0179441	10.1417282	10.1596724	11
50	9.8404593	9.8581505	9.9823087	10.0176913	10.1418495	10.1595407	10
51	9.8405908	9.8580292	9.9825616	10.0174384	10.1419708	10.1594092	9
52	9.8407223	9.8579078	9.9828145	10.0171855	10.1420922	10.1592777	8
53	9.8408537	9.8577863	9.9830673	10.0169327	10.1422137	10.1591463	7
54	9.8409850	9.8576648	9.9833202	10.0166798	10.1423352	10.1590150	6
55	9.8411162	9.8575432	9.9835730	10.0164270	10.1424568	10.1588838	5
56	9.8412474	9.8574215	9.9838259	10.0161741	10.1425785	10.1587526	4
57	9.8413785	9.8572998	9.9840787	10.0159213	10.1427002	10.1586215	3
58	9.8415095	9.8571779	9.9843315	10.0156685	10.1428221	10.1584905	2
59	9.8416404	9.8570561	9.9845844	10.0154156	10.1429439	10.1583596	1
60	9.8417713	9.8569341	9.9848372	10.0151628	10.1430659	10.1582287	0
		Sine.		Tang.		Secant	M

46 Degrees.

A Table of Artificial Sines,

44 *Degrees.*

M	Sine.		Tang		Secant		
0	9.8417713	9.8569341	9.9848372	10.0151628	10.1430659	10.1582287	60
1	9.8419021	9.8568121	9.9850900	10.0149100	10.1431879	10.1580979	59
2	9.8420328	9.8566900	9.9853428	10.0146572	10.1433100	10.1579672	58
3	9.8421634	9.8565678	9.9855956	10.0144044	10.1434322	10.1578366	57
4	9.8422939	9.8564455	9.9858484	10.0141516	10.1435545	10.1577061	56
5	9.8424244	9.8563232	9.9861012	10.0138988	10.1436768	10.1575756	55
6	9.8425548	9.8562008	9.9863540	10.0136460	10.1437992	10.1574452	54
7	9.8426851	9.8560784	9.9866068	10.0133932	10.1439216	10.1573149	53
8	9.8428154	9.8559558	9.9868596	10.0131404	10.1440442	10.1571846	52
9	9.8429456	9.8558332	9.9871123	10.0128877	10.1441668	10.1570544	51
10	9.8430757	9.8557106	9.9873651	10.0126349	10.1442894	10.1569243	50
11	9.8432057	9.8555878	9.9876179	10.0123821	10.1444122	10.1567943	49
12	9.8433356	9.8554650	9.9878706	10.0121294	10.1445350	10.1566644	48
13	9.8434655	9.8553421	9.9881234	10.0118766	10.1446579	10.1565345	47
14	9.8435953	9.8552192	9.9883761	10.0116239	10.1447808	10.1564047	46
15	9.8437250	9.8550961	9.9886289	10.0113711	10.1449039	10.1562750	45
16	9.8438547	9.8549730	9.9888816	10.0111184	10.1450270	10.1561453	44
17	9.8439842	9.8548499	9.9891344	10.0108656	10.1451501	10.1560158	43
18	9.8441137	9.8547266	9.9893871	10.0106129	10.1452734	10.1558863	42
19	9.8442432	9.8546033	9.9896399	10.0103601	10.1453967	10.1557568	41
20	9.8443725	9.8544799	9.9898926	10.0101074	10.1455201	10.1556275	40
21	9.8445018	9.8543564	9.9901453	10.0098547	10.1456436	10.1554982	39
22	9.8446310	9.8542329	9.9903981	10.0096019	10.1457671	10.1553690	38
23	9.8447601	9.8541093	9.9906508	10.0093492	10.1458907	10.1552399	37
24	9.8448891	9.8539856	9.9909035	10.0090965	10.1460144	10.1551109	36
25	9.8450181	9.8538619	9.9911562	10.0088438	10.1461381	10.1549819	35
26	9.8451470	9.8537381	9.9914089	10.0085911	10.1462619	10.1548530	34
27	9.8452758	9.8536142	9.9916616	10.0083384	10.1463858	10.1547242	33
28	9.8454045	9.8534902	9.9919143	10.0080857	10.1465098	10.1545955	32
29	9.8455332	9.8533662	9.9921670	10.0078330	10.1466338	10.1544668	31
30	9.8456618	9.8532421	9.9924197	10.0075803	10.1467579	10.1543382	30
		Sine.		Tang.		Secant	M

45 *Degrees.*

Tangents, and Secants.

44 *Degrees.*

M	Sine.		Tang		Secant		
30	9.8456618	9.8532421	9.9924197	10.0075803	10.1467579	10.1543382	30
31	9.8457903	9.8531179	9.9926724	10.0073276	10.1468821	10.1542097	29
32	9.8459188	9.8529996	9.9929251	10.0070749	10.1470064	10.1540812	28
33	9.8460471	9.8528693	9.9931778	10.0068222	10.1471307	10.1539519	27
34	9.8461754	9.8527449	9.9934305	10.0065695	10.1472551	10.1538246	26
35	9.8463036	9.8526204	9.9936832	10.0063168	10.1473796	10.1536964	25
36	9.8464318	9.8524959	9.9939359	10.0060641	10.1475041	10.1535682	24
37	9.8465599	9.8523713	9.9941886	10.0058114	10.1476287	10.1534401	23
38	9.8466879	9.8522466	9.9944413	10.0055587	10.1477534	10.1533121	22
39	9.8468158	9.8521218	9.9946940	10.0053060	10.1478782	10.1531842	21
40	9.8469436	9.8519970	9.9949466	10.0050534	10.1480030	10.1530564	20
41	9.8470741	9.8518721	9.9951993	10.0048007	10.1481279	10.1529286	19
42	9.8471991	9.8517471	9.9955420	10.0045480	10.1482529	10.1528009	18
43	9.8473267	9.8516220	9.9957047	10.0042953	10.1483780	10.1526733	17
44	9.8474543	9.8514969	9.9959573	10.0040427	10.1485031	10.1525457	16
45	9.8475817	9.8513717	9.9962100	10.0037900	10.1486283	10.1524183	15
46	9.8477091	9.8512465	9.9964627	10.0035373	10.1487535	10.1522909	14
47	9.8478365	9.8511211	9.9967154	10.0032846	10.1488789	10.1521635	13
48	9.8479637	9.8509957	9.9969680	10.0030320	10.1490043	10.1520363	12
49	9.8480909	9.8508702	9.9972207	10.0027793	10.1491298	10.1519091	11
50	9.8482180	9.8507446	9.9974734	10.0025266	10.1492554	10.1517820	10
51	9.8483450	9.8506190	9.9977260	10.0022740	10.1493810	10.1516550	9
52	9.8484720	9.8504933	9.9979787	10.0020213	10.1495067	10.1515280	8
53	9.8485989	9.8503675	9.9982314	10.0017686	10.1496325	10.1514011	7
54	9.8487257	9.8502417	9.9984840	10.0015160	10.1497583	10.1512743	6
55	9.8488524	9.8501157	9.9987367	10.0012633	10.1498843	10.1511476	5
56	9.8489791	9.8499897	9.9989893	10.0010109	10.1500103	10.1510209	4
57	9.8491057	9.8498637	9.9992420	10.0007580	10.1501363	10.1508943	3
58	9.8492322	9.8497375	9.9994947	10.0005053	10.1502625	10.1507678	2
59	9.8493586	9.8496113	9.9997473	10.0002527	10.1503887	10.1506414	1
60	9.8494850	9.8494850	9.1000000	10.0000000	10.1505150	10.1505150	0
		Sine.		Tang.		Secant	M

45 *Degrees.*

a Table of Angle

A Table of the Angles, which every Rhomb (or Point of the Compaſs) maketh with the Meridian.

NORTH.	*SOUTH.*	Points.	*D.*	*M.*	*NORTH.*	*SOUTH.*
		¼	02	49		
		½	05	37		
		¾	08	26		
North by Eaſt	South by Eaſt	1	11	15	N. by W.	S. by W.
		1 ¼	14	04		
		1 ½	16	52		
		1 ¾	19	41		
N. N. E.	S. S. E.	2	22	30	N. N. W.	S. S. W.
		2 ¼	25	19		
		2 ½	28	07		
		2 ¾	30	56		
N. E. by N.	S. E. by S.	3	33	45	N. W. by N.	S. W. by S.
		3 ¼	36	34		
		3 ½	39	22		
		3 ¾	42	11		
North-Eaſt.	South-Eaſt.	4	45	00	North-Weſt.	South-Weſt.
		4 ¼	47	49		
		4 ½	50	37		
		4 ¾	53	26		
N. E. by E.	S. E. by E.	5	56	15	N. W. by W.	S. W. by W.
		5 ¼	59	04		
		5 ½	61	52		
		5 ¾	64	42		
E. N. E.	E. S. E.	6	67	30	W. N. W.	W. S. W.
		6 ¼	70	19		
		6 ½	73	07		
		6 ¾	75	56		
Eaſt by North	Eaſt by South	7	78	45	W. by N.	W. by S.
		7 ¼	81	34		
		7 ½	84	22		
		7 ¾	87	11		
Eaſt.	Eaſt.	8	90	00	Weſt.	Weſt.

tra Capt. Charles Halsted Creditor

Cr. ~~lb s d~~